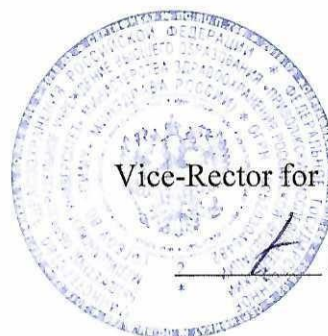



Federal State Budgetary Educational Institution of Higher Education  
"Privolzhsky Research Medical University"  
Ministry of Health of the Russian Federation



APPROVED

Vice-Rector for Academic Affairs

  
E.S. Bogomolova

31 August 2021

## WORKING PROGRAM

Name of the academic discipline: **NORMAL PHYSIOLOGY**

Specialty: **31.05.01 GENERAL MEDICINE**

*(code, name)*

Qualification: **GENERAL PRACTITIONER**

Department: **DEPARTMENT OF NORMAL PHYSIOLOGY NAMED AFTER N.YU. BELENKOV**

Mode of study:

**FULL-TIME**

Labor intensity of the academic discipline: \_\_\_\_\_ **252 academic hours**

Nizhny Novgorod

2021

The working program has been developed in accordance with the Federal State Educational Standard of Higher Education in the qualification 31.05.01 «General medicine», approved by the order of the Ministry of Science and Higher Education of the Russian Federation № 988 dated August 12, 2020 г.

**Developers of the working program:**

Mukhina I.V., PhD, DrSci, Professor, Head of the Normal Physiology Department named after N.Yu. Belenkov

Volkova I.F., PhD, Associate Professor, Associate Professor of the Normal Physiology Department named after N.Yu. Belenkov

The work program was reviewed and approved at the Normal Physiology Department meeting, on 15.04.2021 (Protocol No. 4)

Head of the Normal Physiology Department  
named after N.Yu. Belenkov, PhD, DrSci, Prof

  
(signature)

Mukhina I.V.

April 15, 2021

AGREED

Deputy Head of EMA ph.d. of biology  
(signature)



Lovtsova L.V.

April 15, 2021

## **1. The purpose and objectives of mastering the discipline "Normal physiology"**

**1.1. The purpose of mastering the discipline:** participation in the formation of the competencies of the UC -1, GPC -5.

Tasks of the discipline:

### **1.2. Objectives of the discipline**

As a result of mastering the discipline, the student must:

#### **To know:**

- Physiological terms;
- General physiological patterns underlying the processes occurring in the human body;
- Physiological processes occurring in human organs and systems and their dynamics in different age periods;
- Functional systems of the body, their self-regulation under the influence of factors of the internal and external environment;
- Methods of functional and laboratory diagnostics (electrocardiography - ECG, methods for studying pulse and blood pressure, spirometry, spirography, methods for studying sensory systems, higher nervous activity, metabolism, hematological studies), methods of experimental work.
- Principles of analysis and evaluation:
  - physiological processes occurring in human organs and systems,
  - functional systems of the human body and their self-regulation under the influence of factors of the internal and external environment,
  - results of functional and laboratory diagnostic methods,
  - results of experimental work.

#### **Be able to:**

- Apply physiological terms in professional activity;
- Analyze and evaluate:
  - functional state of various cellular, tissue and organ structures;
  - functional systems of the human body and their self-regulation under the influence of factors of internal and external environment;
  - results of laboratory and functional diagnostic methods (general blood analysis, determination of blood group by the ABO system and the rhesus system, general urine analysis, spirometry, spirography, methods for studying arterial pulse and pressure, sensory systems, metabolism);
- Perform practical work under the guidance of a teacher; analyze and evaluate the results of practical work, draw conclusions corresponding to the goal and the results of experiments.

#### **Possess:**

- Skills of self-measurement of blood pressure and pulse palpation;
- Skills of independent use of the physiological conceptual apparatus.

## **2. Position of the academic discipline in the structure of the General Educational Program of Higher Education (GEP HE) of the organization.**

2.1 The discipline "Normal physiology" (B1.O.17) belongs to the mandatory part of Block 1 "Discipline" (B1.O) of the general educational program of higher education.

**2.2 The following knowledge, skills and abilities formed by previous academic disciplines are required for mastering the discipline:**

Latin language

- history of medicine
- psychology and pedagogy
- Physics, mathematics
- Biology
- chemistry

- anatomy
- histology, embryology, cytology
- biochemistry

**2.3 Mastering the discipline is required for forming the following knowledge, skills and abilities for subsequent academic disciplines:**

- pathophysiology, clinical pathophysiology
- pharmacology;
- propaedeutics of internal diseases;
- general surgery;
- hygiene
- pediatrics;
- neurology, medical genetics, neurosurgery;
- psychiatry, medical psychology;
- otorhinolaryngology;
- ophthalmology;
- Midwifery;
- gynecology;
- anesthesiology, intensive care and intensive care.

**3. Deliverables of mastering the academic discipline and metrics of competence acquisition**

Mastering the discipline aims at acquiring the following universal (UC) and general professional (GPC) competencies:

No.	Competence code	The content of the competence (or part of it)	Code and name of the indicator of the competence acquisition metric	As a result of studying the discipline, students should:		
				Know	Be Able to	Possess
1.	UC -1	He is able to carry out a critical analysis of problem situations based on a systematic approach, to develop a strategy of actions	ИYK 1.1 Knows: methods of critical analysis and evaluation of modern scientific achievements; basic principles of critical analysis ИYK 1.2 Can: acquire new knowledge based on analysis, synthesis, etc.; collect data on complex scientific problems related to the professional field; search for information and solutions based on actions, experiment and experience.	Principles of analysis and evaluation of physiological processes occurring in human organs and systems; Principles of analysis and evaluation of functional systems of the human body and their self-regulation under the influence of factors of internal and external environment; Principles of analysis and evaluation of the results of functional and laboratory diagnostic methods (ECG, pulse and blood pressure research methods, spirometry, methods of research of sensory systems, higher nervous activity thermometry, hematological studies); Principles of analysis and evaluation of experimental results.	Analyze the functional state of various cellular, tissue and organ structures; Analyze the functional systems of the human body and their self-regulation under the influence of factors of the internal and external environment; Analyze the results of laboratory and functional diagnostic methods; Analyze the results of practical work, draw conclusions corresponding to the set goal and the results of experiments.	Independent measurement skills blood pressure and pulse palpation; Skills of independent use of physiological functions of the conceptual apparatus.

4.	GPC -5	Able to assess morphofunctional, physiological states and pathological processes in the human body to solve professional tasks	<p>ИОПК-5.1 Knows: anatomy, histology, embryology, topographic anatomy, physiology, pathological anatomy and physiology of human organs and systems</p> <p>ИОПК 5.2 Able to: evaluate the basic morphofunctional data, physiological states and pathological processes in the human body.</p>	<p>Physiological terms; General physiological patterns underlying the processes occurring in the human body; Physiological processes occurring in human organs and systems and their dynamics in different age periods; Functional systems of the human body, their regulation and self-regulation under the influence of factors of internal and external environment; Methods of functional and laboratory diagnostics (ECG, methods of pulse and blood pressure research, spirometry, spirometry, methods of research of sensory systems, metabolism, higher nervous activity hematological studies); Methods of practical work.</p>	<p>Apply physiological terms in professional activity; Evaluate the physiological states of various cellular, tissue and organ structures; Evaluate the functional systems of the human body and their self-regulation under the influence of internal and external environmental factors; Evaluate the results of laboratory and functional diagnostic methods; Perform practical work under the guidance of a teacher; Evaluate the results of practical work, draw conclusions corresponding to the set goal and the results of experiments.</p>	<p>Self-measurement skills blood pressure and pulse palpation; Skills of independent use of physiological conceptual apparatus.</p>
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#### 4. Sections of the discipline and competencies that are formed when mastering them:

No.	Competence code	Name of the discipline section	The content of the section in didactic units
1.	UC -1 GPC -5	Introduction to the subject. Basic concepts of physiology. Regulation of physiological functions.	<p>Introduction to physiology, connection of physiology with medical sciences. Physiology as a scientific basis for assessing the state of health, functional state and working capacity of a person.</p> <p>Brief description of the stages of development of normal physiology: empirical, anatomical and physiological, functional. Formation and development of physiology in the XIX-XX centuries. Contribution of foreign and domestic physiologists to the development of world physiological science. Modern problems, tasks and trends in the development of physiology.</p> <p>The concept of an organism, its constituent elements. Levels of morpho-functional organization of the human body. The concept of physiological functions. The relationship of structure and function.</p> <p>The unity of the organism and the external environment. The concept of the internal environment of the body and its components (blood, lymph, intercellular fluid). The concept of physiological constants. Ideas about plastic and rigid constants. Concepts of homeostasis, homeokinesis. Physiological adaptive response.</p> <p>The concept of regulation of functions. The basic principles of the formation and regulation of physiological functions: deviation, perturbation, prediction. Levels and mechanisms of regulation of functions (physico-chemical, nervous, humoral). The idea of self-regulation of the constancy of the internal environment of the body.</p> <p>System organization of functions (I.P. Pavlov, P.K. Anokhin). Levels of the system organization. The physiological system. Functional system, its components (P.K. Anokhin). The concept of a system-forming factor. Principles of organization and interaction of functional systems</p>

2.	UC -1 GPC -5	Physiology of excitable systems.	<p>The history of the discovery of bioelectric phenomena in living tissues (experiments by L. Galvani, K. Matteuch). Irritability as the basis of tissue reaction to irritation. Classification of stimuli. The concept of excitability and excitation.</p> <p>Structure and functions of biological membranes. Active and passive transport of substances through the membrane. Ion channels and pumping mechanisms.</p> <p>Resting membrane potential. Membrane-ion theory of rest potential formation (A. Hodgkin, A. Huxley, B. Katz). Methods for registering the resting potential.</p> <p>Excitement. Electrophysiological characteristics of the excitation process Action potential and its phases. Critical level of depolarization. Threshold potential. Ionic excitation mechanisms. Conditions for the occurrence of arousal. Features of local and spreading excitation processes. Practical use of registration of biological flows in medicine.</p> <p>Physiological properties of excitable tissues. Excitability, its level and evaluation criteria: threshold strength, time, gradient of the increase in the strength of the stimulus over time. The "force-time" curve. The concept of rheobase, chronaxy, useful time.</p> <p>The influence of the parameters of the stimulus (strength, time, the steepness of the increase in force over time) on the nature of the response of excitable systems. The laws of irritation operating within a single cell. The laws of irritation for tissue.</p> <p>Dependence of the nature of the biosystem response on its functional state. Change in excitability in the process of arousal. Optimal and pessimal reactions. The concept of lability. A measure of lability.</p> <p>Classification of nerve fibers. Physiological properties of nerve fibers. Mechanisms of excitation along nerve fibers. The laws of excitation in the nerves. Physiological properties of skeletal muscles. The concept of a motor unit. Structural features of the membrane and sarcomeres of skeletal muscle fibers. The mechanism of muscle contraction. The time ratio of the cycle of excitation, excitability and single contraction of skeletal muscle fiber. Types of muscle contractions depending on the conditions of contraction. Types of muscle contractions depending on the frequency of stimulation. Muscle strength. Muscle fatigue. Physiological features and properties of smooth muscles.</p>
3.	UC -1 GPC -5	Physiology of the central nervous system (CNS).	<p>Functions of the central nervous system. Methods of studying the functions of the central nervous system. Morphofunctional organization of a neuron as a unit of the nervous system. Classification of neurons. Integrative function of a neuron. Glial elements of the brain, their functional significance.</p> <p>Reflex. Classification of reflexes. Principles of reflex theory. Morphological basis of somatic and vegetative reflexes. The concept of the adaptive result of reflex activity.</p> <p>The concept of synapse. Classification of synapses. The structure of synapses. Functional properties of electrical and chemical synapses. The mechanism of signal transmission in the chemical synapse. Types of synaptic neurotransmitters and neuromodulators. The occurrence of local and propagating excitations in the neuron.</p> <p>The nature of the propagation of excitation in the central nervous system (divergence, convergence, circulation in neural networks).</p> <p>Patterns of excitation propagation along the reflex arc (unilateral conduction, central delay, summation of excitations, transformation of the excitation rhythm, post-tetanic potentiation, aftereffect).</p> <p>The concept of a nerve center. Properties of nerve centers (low lability, high fatigue, high sensitivity to neurotropic agents, hypoxia, acidosis, plasticity).</p> <p>Inhibition in the central nervous system. The history of the discovery of central braking. Mechanisms of inhibition (presynaptic, postsynaptic, postactivation and pessimal). Mechanisms of interaction of excitatory (EPSP) and inhibitory (IPSP) influences on the neuron. Types of inhibition (lateral, recurrent, reciprocal). The importance of inhibition in the activity of the body.</p> <p>Principles of coordination activity of the Central Nervous System. Reciprocal interaction, dominant, common end path, feedback, subordination, facilitation and</p>

			<p>occlusion.</p> <p><b>The role of various departments of the central nervous system in the regulation of physiological functions.</b></p> <p>Spinal cord functions.</p> <p>Functions of the medulla oblongata. Functions of the midbrain.</p> <p>The cerebellum, its functions. The thalamus. Functional characteristics of the thalamus nuclei. Hypothalamus, its role in the regulation of autonomic functions, in the formation of motivations and emotions, in the regulation of the endocrine system.</p> <p>Limbic system, its role in the formation of motivations and emotions.</p> <p>The cerebral cortex, its neural organization; localization of functions in the cerebral cortex; the significance of projection and associative fields of the neocortex Cortical-subcortical and cortical-visceral relationships (K.M. Bykov). Functional asymmetry of the hemispheres in humans.</p> <p>The concept of muscle tone. Reflex nature and functional significance of muscle tone.</p> <p>Types of proprioceptors, their localization, structure, role in maintaining muscle tone. The mechanism of occurrence and regulation of muscle tone at the spinal level (spinal tone).</p> <p>Ways and mechanisms of influence of the structures of the medulla oblongata on muscle tone. The mechanism of occurrence of the state of decerebration rigidity (contractile tone) a bulbar animal.</p> <p>Structures of the midbrain involved in the formation of mesencephalic tone. Plastic tone in a diencephalic animal.</p> <p>The participation of components of the striapallidar system and the cerebral cortex in the regulation of muscle tone.</p> <p>Types of setting-tonic reflexes (static and statokinetic). Conditions of their occurrence. The participation of the structures of the spinal cord, medulla oblongata and medulla in their implementation.</p> <p>The autonomic (autonomic) nervous system. Its functions. Physiological features of the sympathetic, parasympathetic and metasympathetic divisions of the autonomic nervous system. The main types of mediators and receptors. The role of various departments of the central nervous system in the regulation of the functions of the autonomic nervous system.</p>
4.	UC -1 GPC -5	Physiology of the endocrine system	<p>The main components of the endocrine system (local and diffuse endocrine systems). The concept of the endocrine glands. Secretory cycle. Types of endocrine glands. Central and peripheral glands. Hypothalamic-pituitary system.</p> <p>Functional signs of hormones. Classification of hormones: by chemical nature (protein-peptide, steroid, amino acid derivatives), by functional feature (tropic, triggering, effector).</p> <p>Methods of transporting hormones by blood. Mechanisms of action of hormones on target cells (membrane, cytosolic-nuclear).</p> <p>Types of physiological action (metabolic, morphogenetic, kinetic, corrective) and the value of hormones.</p> <p>Nervous and humoral regulation of the activity of the endocrine glands. The role of negative feedbacks (ultrashort, short, long) in the regulation of the endocrine glands. Hormones of the endocrine glands (hypothalamus, pituitary, epiphysis, thyroid, thymus, parathyroid, pancreas, adrenal glands, genital, placenta), their effect on metabolic processes and body functions.</p>
5.	UC -1 GPC -5	Blood physiology	<p>The concept of blood, the blood system. Blood functions. The amount of circulating blood, its composition. The concept of hematocrit. Plasma composition. The main constants of blood, their magnitude and functional significance. The idea of the self-regulatory principle of the mechanism of maintaining blood constants.</p> <p>Shaped elements of blood. Erythrocytes, their functions, quantity, counting methods. The rate of erythrocyte sedimentation, factors affecting its magnitude. Hemoglobin, its structure, compounds, functional significance. The hemoglobin content in the blood. Methods of determination.</p> <p>The concept of hemolysis, its types and plasmolysis.</p> <p>Leukocytes, their value, quantity, counting methods. Leukocyte formula.</p>

			<p>Platelets, their value, quantity.</p> <p>The idea of the protective function of blood and its manifestations (immune reactions, blood clotting).</p> <p>Blood groups as manifestations of the immune specificity of the body. Varieties of blood group systems (ABO, Rh), their significance for obstetric and surgical practice. Determination of blood group membership according to the ABO system. Determination of Rh-blood affiliation. Rules of blood transfusion. Physiological justification of conducting tests for individual and biological compatibility. Plasma-substituting solutions, the requirements for them.</p> <p>Hemostasis and the system of regulation of the aggregate state of blood. Stages of hemostasis: vascular-platelet hemostasis, its phases and factors; coagulation hemostasis, its phases and clotting factors; retraction and fibrinolysis, phases and factors. Anticoagulation mechanisms. The concept of an anti-folding system. Anticoagulants, classification, mechanisms of action. Factors that accelerate and slow down the process of blood clotting. Interaction of coagulation and anti-coagulation systems. Methods of blood clotting research.</p> <p>Features of the blood system in children: shaped elements, blood plasma, formation of blood group membership in ontogenesis.</p>
6.	UC -1 GPC -5	Physiology of respiration .	<p>Respiration, its main stages, importance for the body. External breathing. The composition of inhaled, exhaled and alveolar air. Biomechanics of inhalation and exhalation. Pressure in the pleural cavity, its nature and physiological significance. Changes in intrapleural pressure during inhalation and exhalation. The concept of pneumothorax. Anatomical, physiological and functional dead spaces. Pulmonary volumes and capacities. Reserve capabilities of the respiratory system. Spirometry, spirometry, pneumotachometry.</p> <p>The concept of gas exchange. Causes of gas exchange. Partial pressure (voltage) of the gas. Gas exchange in the lungs. Factors contributing to this process. Aerogematic barrier. The diffusion capacity of the lungs. Gas exchange in tissues. Oxygen transport by blood. Graph of oxyhemoglobin dissociation. Factors affecting the formation and dissociation of oxyhemoglobin. The concept of oxygen capacity of blood. Transport of carbon dioxide by blood. The value of carbanhydrase.</p> <p>The concept of the respiratory center, modern ideas about its structure and localization. Automation of the respiratory center. Types of respiratory neurons of the medulla oblongata. Mechanisms of phase change of respiration. Factors of respiratory regulation, mechanisms of their action. Protective respiratory reflexes. Functional relationship of the processes of breathing, chewing and swallowing.</p> <p>Breathing with increased and decreased barometric pressure. Breathing under conditions of physical exertion. Regulation of respiration during muscular work (humoral and nervous mechanisms).</p> <p>The scheme of the functional system that ensures the maintenance of the constancy of the gas composition of the blood.</p> <p>The mechanism of the newborn's first breath.</p>
7.	UC -1 GPC -5	Metabolic bases of physiological functions. Thermoregulation.	<p>The concept of metabolism and energy. The idea of the energy balance of the body. Caloric value of various nutrients.</p> <p>The main exchange, the conditions for determining the main exchange, the factors affecting its value. Proper basic exchange. Daily exchange and its components. Methods of direct and indirect calorimetry. The physiological basis of nutrition. Principles of the organization of rational nutrition. The concept of thermoregulation. The temperature scheme of the body, its daily fluctuations. The constancy of the temperature of the internal environment of the body, as a necessary condition for the normal course of metabolic processes. Physical and chemical thermoregulation.</p> <p>A functional system that ensures the maintenance of a constant temperature of the internal environment of the body. The concept of hypo- and hyperthermia.</p>
8.	UC -1 GPC -5	Physiology of excretion.	<p>The concept of isolation, its role in maintaining homeostasis. The concept of the excretory system.</p> <p>The kidney is the main excretory organ. Kidney function. Morpho-functional characteristics of the nephron, features of its blood supply. Self-regulation of renal blood flow.</p>



			<p>The process of urination. The mechanism of glomerular filtration, its regulation. Primary urine, the difference in its composition from blood plasma. The mechanism of secondary urine formation, its quantity and composition. Reabsorption. Mandatory (obligate) and selective (optional) reabsorption. Active and passive processes underlying reabsorption. Rotary-countercurrent mechanism of urine concentration at the level of the Henle loop and collecting tube. Mechanisms of regulation of the reabsorption process. The role of the main humoral factors: aldosterone, antidiuretic hormone and natriuretic factor. Secretion in the renal tubules.</p> <p>The idea of the homeostatic functions of the kidneys (regulation of fluid volume, osmotic pressure, acid-base balance, the amount of inorganic and organic substances, blood pressure, hematopoiesis).</p> <p>The concept of an artificial kidney.</p>
9	UC -1 GPC -5	Physiology of digestion.	<p>Digestion, its importance in life support. Digestive (secretory, motor and suction) and non-digestive functions of the digestive system. Classification of digestive processes (autolic, symbiotic and proper digestion; intracellular and extracellular digestion, cavity and membrane digestion). Digestive conveyor.</p> <p>General principles of neuro-humoral regulation of digestive tract functions. Gastrointestinal hormones.</p> <p>Digestion in the oral cavity. Chewing, its nature, self-regulation. Masticationography. Salivary glands and methods of studying their functions. Saliva, its composition and properties. The value of saliva. Nervous and humoral mechanisms of regulation of salivation and salivation. Adaptive nature of salivation.</p> <p>Swallowing, its phases and mechanisms.</p> <p>Digestion in the stomach. Functions of the stomach. Quantity, composition and properties of gastric juice. The value of the components of gastric juice. Phases of gastric secretion, their neuro-humoral mechanisms. Analysis of gastric secretion curves for meat, bread and milk. Methods of investigation of secretory function of the stomach.</p> <p>Motor activity of the stomach, types of motor skills. Nervous and humoral factors affecting the motor and evacuation functions of the stomach. The absorption function of the stomach.</p> <p>Digestion in the small intestine. Functions of the pancreas. The amount, composition and properties of pancreatic juice. Mechanisms of regulation of pancreatic secretion. Liver function. Bile, its quantity, composition, value for digestion. Mechanisms of bile formation and bile excretion, their regulation. Quantity, properties, composition of intestinal juice. Methods of studying the secretory activity of the intestine, mechanisms of its regulation. Motor function of the small intestine. Types of abbreviations and methods of their study. Regulation of motor activity of the small intestine. Absorption in the small intestine, its mechanisms.</p> <p>Digestion in the large intestine. Motor activity of the colon, its features, significance, mechanisms of regulation. The composition of colon juice. Absorption in the large intestine .</p>
10.	UC -1 GPC -5	Physiology of blood circulation .	<p>The concept of the physiological circulatory system (cardiovascular system). Functions of the heart. Morpho-functional features of the organization of the heart. Heart cavities, valvular apparatus, typical and atypical cardiomyocytes, cardiac conduction system. The concept of functional syncytia of the heart.</p> <p>Physiological properties of the heart muscle. The emergence and spread of arousal in the heart. Automatism, its nature and gradient. Ionic mechanisms of excitation of atypical cardiomyocytes.</p> <p>Excitability and the process of excitation of the contractile myocardium. Action potential, phases, ionic mechanisms. The change in excitability during the excitation of typical cardiomyocytes. Electromechanical coupling. Extrasystole. Compensatory pause.</p> <p>Conduction of the heart. Features of excitation in the heart. Conduction disorders, heart blockages.</p> <p>Contractility of the heart muscle. Features of contraction compared to skeletal muscle.</p>

			<p>Cardiac cycle, its phase structure. Changes in the tone of the muscle walls of the heart cavities, changes in their volumes, pressure and condition of the valve apparatus in different phases of the cardiocycle. The main indicators of the pumping function of the heart (end-diastolic, systolic, end-systolic and minute heart volumes). Mechanical, sound, electrical manifestations of cardiac activity. Physiological basis of electrocardiography.</p> <p>Mechanisms of regulation of cardiac activity. Hemodynamic mechanism of regulation (hetero- and homeometric). Nervous extracardial regulation mechanism. Reflexogenic zones, nerve centers, centrifugal nerves. Features of sympathetic and parasympathetic innervation of the heart muscle. Mechanisms of parasympathetic and sympathetic influences on the work of the heart. The idea of chrono-, batmo-, dromo-, inotropic effects as manifestations of regulatory influences on the work of the heart. Nervous intracardiac regulation. Intracardiac peripheral reflexes. The role of the hypothalamus, limbic system and cerebral cortex in the regulation of cardiac activity.</p> <p>Humoral mechanism of regulation. The effects of hormones, electrolytes and other factors on the parameters of heart activity.</p> <p>Сердечная деятельность при физической нагрузке.</p> <p>Functional classification of blood vessels (shock-absorbing, resistive, exchange, capacitive, shunting). The main characteristics of hemodynamics are the linear and volumetric velocity of blood movement in different parts of the bloodstream; their determining factors, the reasons for their changes. Blood pressure. Factors that determine the amount of blood pressure. The value of blood pressure in various parts of the vascular bed. Types of blood pressure, the concepts of systolic, diastolic, pulse and average blood pressure, their nature and clinical significance. Methods of measuring blood pressure (direct and indirect). The methods of Riva-Rocci and Korotkov, the technique of their application. The concept of vascular tones, the idea of the mechanisms of their occurrence.</p> <p>Arterial pulse, its characteristics. Mechanisms of pulse wave propagation, its velocity. Arterial pulse examination (palpation, sphygmography).</p> <p>The concept of vascular tone, its nature. Basal tone of the vessel. Myogenic, nervous, humoral regulation of vascular tone.</p> <p>Vasomotor center (pressor and depressor departments). Peripheral and central effects on the activity of neurons of the vasomotor center.</p> <p>A functional system that maintains a normal blood pressure level.</p> <p>Morphofunctional characteristics of the microcirculatory bed. Capillary blood flow and its features. Metabolic processes in the capillary bed, their mechanisms. Lymph formation and lymph circulation.</p>
11.	UC -1 GPC -5	Physiology of sensory systems .	<p>The concept of sensory systems. Perception and analysis of stimuli. Psychophysiological aspects of perception. Characteristics of sensation (sensory image).</p> <p>General principles of the structure of sensory systems (multilayering, multilevel, multi-channel, bi-hemispheric).</p> <p>Functions of the peripheral (receptor) part of the sensory system. Classification of receptors according to the criteria: reception of internal or external stimuli; the nature of an adequate stimulus; the nature of sensations; the threshold of irritation; the speed of adaptation; the connection of the receptor with the sensory neuron. Functional properties of receptors: modal specificity, high sensitivity, high specialization, adaptability. Functions of receptors: signal detection, encoding of its parameters, signal discrimination. Functional properties and features of the organization of the conductor department of the sensory system (morphofunctional characteristics of specific, non-specific and associative channels of information transmission). Functions of central departments of analyzers (detection, coding, discrimination, passive and active processing, signal detection, sensory image formation). An idea of the interaction of sensory systems.</p> <p>Morpho-functional characteristics of the departments of the visual sensory system. The eye, its refractive media. Refraction, accommodation, their anomalies. The concept of visual field and visual acuity. Methods of their determination. Pupillary reflex. The receptor apparatus of the visual analyzer.</p>

			<p>Photochemical processes in the retina as a mechanism for encoding information. Mechanisms of reception and perception of color. The main types of color perception disorders. Definition of color vision. The role of subcortical and cortical visual centers in visual perception.</p> <p>Morpho-functional characteristics of the departments of the auditory sensory system. Sound-trapping formations, sound-conducting pathways and sound-receiving apparatus. Mechanisms of sound reception. Encoding of amplitude-frequency parameters of sound. The physiological basis of the formation of a sound image. Binaural hearing. Methods of research of the auditory sensory system.</p> <p>General morphological and functional organization of the departments of the skin sensory system. Tactile and temperature sensor systems as its components. Classification of tactile receptors, their structural and functional differences. Methods of research of the tactile sensory system. The concept of the spatial threshold of tactile sensitivity. Classification of thermoreceptors. Methods of investigation of the temperature sensor system.</p> <p>General morphological and functional organization of the taste sensory system departments. Receptors of the taste sensory system. Taste buds, taste buds. Types of taste buds of the tongue. The mechanism of reception and perception of taste. Methods of research of the taste sensory system.</p> <p>General morphological and functional organization of the olfactory sensory system departments. The mechanism of reception and perception of smell. Methods of research of the olfactory sensory system.</p> <p>The physiology of pain. The concept of pain, nociception. Pain functions. Classification of pain. Pain as an integrative reaction of the body to the damaging effect of an irritant. Components of the pain response.</p> <p>Morphofunctional characteristics of the departments of the pain sensory system. The role of the thalamus and the cerebral cortex in the integration and analysis of pain excitation. The concepts of antinociception and antinociceptive system (ANCS). Components and functions of the ANUS.</p> <p>ANCS levels. Neurochemical and neurophysiological mechanisms of the ANUS. Interaction of nociceptive and antinociceptive systems.</p> <p>The concept of pain threshold. Algometry.</p> <p>Physiological basis of anesthesia.</p>
12.	UC -1 GPC -5	Physiology of higher nervous activity.	<p>The concept of higher nervous activity. The idea of the manifestations of higher nervous activity (innate and acquired forms of behavior, higher mental functions). The concept of conditioned reflex. The history of the discovery of conditioned reflexes. The significance of the works of I.P. Pavlov and his followers in the creation of the doctrine of conditioned reflexes and the physiology of the higher nervous activity.</p> <p>Comparative characteristics of conditional and unconditional reflexes. The importance of conditioned reflexes in the adaptation of animals and humans to the conditions of existence.</p> <p>Rules and stages of development of conditioned reflexes. Classification of conditioned reflexes by criteria: the ratio of the nature of conditional and unconditional stimuli (natural and artificial); the biological significance of the unconditional stimulus (food, defensive, etc.); the type of receptors excited by the conditional stimulus (sound, light, etc.); the relationship of the conditional stimulus to the first or second signaling systems; the complexity of the conditioned reflex (reflexes 1, 2, 3, etc. orders of magnitude). The concept of time connection. Pavlovian and modern ideas about the localization levels of time connection and the mechanisms of its formation.</p> <p>Inhibition in the higher nervous activity, its types: unconditional (transcendental and external), conditional (fading, differentiating, conditional brake, lagging), conditions of their occurrence. Modern understanding of the mechanisms of braking in the higher nervous activity. The importance of inhibition of conditioned reflexes for the organization of adaptive human activity.</p> <p>Concepts of the mental activity. Types of basic mental functions (sensation, perception, representation, attention, emotion, motivation, memory, speech, thinking, consciousness).</p>

			<p>The concept of speech. Types of speech and functions of speech. Understanding of the mechanisms of speech, functional asymmetry of the cerebral cortex associated with the development of speech in humans.</p> <p>The concept of purposeful behavior. Analysis of the components of the functional system of the behavioral act. Biologically and socially determined types of purposeful activity .</p> <p>Analytical and synthetic activity of the cerebral cortex. Dynamic stereotype, its physiological essence and meaning.</p> <p>Types of the higher nervous activity, their classification, characteristics, methods of determination.</p> <p>The role of the reticular formation in the integrative activity of the brain. Dream. Theories about the mechanisms of sleep. Memory, a modern understanding of the mechanisms of memory. Motivations, emotions, their biological role. Mechanisms of motivation. The role of motivations in the formation of conditioned reflex activity and human behavior. Theories of emotions. Vegetative and somatic components of emotions. The role of various brain structures in the formation of emotional states. The influence of emotions on the state of health: emotional stress, its role in the emergence of neuroses. I.P. Pavlov's teaching on the first and second signaling systems. Development of the second signaling system in children.</p>
13.	UC -1 GPC -5	Physiology of functional states.	<p>The concept of "functional state". The functional state of a person in various conditions: physical and mental work, emotionally stressful activity.</p> <p>Features of labor activity in the conditions of modern production (hypokinesia, monotonous work). Features of the functional state during monotonous work. Factors contributing to and hindering the development of a state of monotony. Prevention of monotony.</p> <p>Health and work. The concept of a healthy lifestyle. Factors affecting the state of health. Features of health preservation in modern conditions. Fatigue, its mechanisms. The concept of passive and active recreation.</p>

## 5. Volume of the academic discipline and types of academic work

Type of educational work	Labor intensity		Labor intensity by semester (AH)	
	volume in credit units (CU)	volume in academic hours (AH)	3	4
	<b>Classroom work, including</b>	<b>3,7</b>	<b>132</b>	<b>66</b>
Lectures (L)	0,84	28	14	14
Laboratory practicum (LP)*				
Practicals (P)	2,86	104	52	52
Clinical practice (CP)				
Seminars (S)				
Student's individual work (SIW)	<b>2,3</b>	<b>84</b>	<b>42</b>	<b>42</b>
Student's research work (SRW)				
Mid-term assessment: exam	<b>1</b>	<b>36</b>		<b>36</b>
<b>TOTAL LABOR INTENSITY</b>	<b>7</b>	<b>252</b>	<b>108</b>	<b>144</b>

## 6. The content of the discipline

### 6.1. Sections of the discipline and types of classes:

No.	Name of the discipline section	Types of lessons (in AH)*
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	Semester No.		L	LP	P	CP	S	SIW	Total
1.	3	Introduction to the subject. Basic concepts of physiology. Regulation of physiological functions.	2,5		6			5	13,5
2.	3	Physiology of excitable systems.	2,5		14			11	27,5
3.	3	Physiology of the central nervous system.	5		18			15	38
4.	3	Physiology of sensory systems.	3		8			6	17
5.	3	Physiology of higher nervous activity.	1		6			5	12
6.	4	Physiology of blood circulation.	4		23			18	45
7.	4	Physiology of the endocrine system.	2		-			3	5
8.	4	Physiology of respiration.	2		4			4	10
9.	4	Blood physiology.	2		10			6	18
10.	4	Physiology of digestion.	2		5			3	10
11.	4	Physiology of excretion.	2		5			2	9
12.	4	Metabolic bases of physiological functions. Thermoregulation.	-		5			3	8
13.	4	Physiology of functional states.	-		-			3	3
		Exam							36
		Total	28		104			84	252

\* - L – lectures; LP – laboratory practicum; P – practicals; S – seminars; SIW – student’s individual work.

## 6.2. Thematic schedule of educational work types:

### 6.2.1. Thematic plan of lectures\*:

No.	Topic name and content	Volume in academic hours (AH)	
		Semester 3	Semester 4
1	<p><b>INTRODUCTION TO PHYSIOLOGY. PHYSIOLOGY AND BIOPHYSICS OF EXCITABLE TISSUES</b></p> <p>Introduction to physiology, connection of physiology with medical sciences. Tasks of physiology, modern problems and development trends. Basic concepts of physiology.</p> <p>The doctrine of biological flows. Resting membrane potential. The potential of action, its nature.</p> <p>Bioelectric phenomena in excitable systems.</p> <p>The doctrine of biological currents. Currents of rest and action. Resting membrane potential. Membrane-ion theory of rest potential formation and methods of its registration. The potential of an action, its phases, their origin.</p>	0,5	
2	<p>Conditions for the occurrence of excitation. The laws of irritation.</p> <p>General properties of excitable systems.</p> <p>The dependence of the nature of the response of the biosystem on its functional state and on the parameters of the active irritation (the laws of irritation). Change in excitability in the process of excitation.</p>	1	

	Optimal and pessimal reactions. Lability as a property of excitable biosystems.		
3	<p style="text-align: center;"><b>CONTROL OF PHYSIOLOGICAL FUNCTIONS</b></p> <p>Levels of structural and functional organization of the organism. Homeostasis and homeokinesis. Basic principles, methods and mechanisms of regulation of functions.</p> <p>Types of humoral regulation (autocrine, paracrine, endocrine). Glands of internal secretion. Hormones, their main signs, the physiological effect of hormones. Hypothalamic-pituitary system. The role of the endocrine glands in the general system of regulation of functions. The role of tissue hormones in the regulation of organs and tissues of the body.</p> <p>Nervous regulation. Principles of Sechenov-Pavlov reflex theory. Feedback.</p> <p>The concept of self-regulation. Theory of functional systems by P.K. Anokhin.</p>	2	
4	<p style="text-align: center;"><b>PHYSIOLOGY OF THE CENTRAL NERVOUS SYSTEM (CNS)</b></p> <p>Physiology of the synapse. Neurotransmitters and neuromodulators. Nerve centers. Features of excitation in the central nervous system (unilateral conduction, central delay, spatial and temporal summation, transformation of the excitation rhythm, post-tetanic potentiation).</p>	1	
5	<p style="text-align: center;">Inhibition in the central nervous system. General principles of CNS coordination activity</p> <p>Concepts of inhibition in the central nervous system. The importance of inhibition. Mechanisms and types of inhibition. Principles of reciprocity, feedback, facilitation, occlusion, path tracing, common end path, dominance, hierarchy of multilevel regulation.</p>	2	
6	<p style="text-align: center;"><b>MUSCLE TONE</b></p> <p>Types of tone (spinal, contractile and plastic tone), mechanisms of regulation.</p>	1	
7	<p style="text-align: center;"><b>PHYSIOLOGY OF THE AUTONOMIC NERVOUS SYSTEM.</b></p> <p>Sympathetic, parasympathetic and metasympathetic divisions of the ANS, their structural and functional differences. The problem of regulation of vegetative functions in the body.</p>	1	
8	<p style="text-align: center;"><b>PHYSIOLOGY OF SENSORY SYSTEMS</b></p> <p>The concept of sensory systems. Psychology of perception. The principles of the organization of sensor systems are multilayered, multilevel, multi-channel, bi-hemispheric. Sensory receptors, their physiological properties. Signal detection. Encoding of information in the peripheral department of analyzers.</p>	1	
9	<p style="text-align: center;"><b>THE PHYSIOLOGY OF PAIN.</b></p> <p>Components of pain. Classification of pain. Nociceptive and antinociceptive systems.</p>	2	
10	<p style="text-align: center;"><b>PHYSIOLOGY OF HIGHER NERVOUS ACTIVITY</b></p> <p>Conditioned reflex, conditions of its formation and inhibition. Physiology of memory, motivations and emotions, sleep.</p>	1	
11	<p style="text-align: center;"><b>PHYSIOLOGY OF BLOOD CIRCULATION</b></p> <p style="text-align: center;">Physiological properties of the heart.</p>		2

	<p>The value of blood circulation. Morphological characteristics and physiological properties of the heart muscle (excitability, conductivity, contractility, automatism). The conducting system of the heart, its functional features.</p> <p>Regulation of cardiac activity</p> <p>Pumping function of the heart. Systolic and minute blood volumes, cardiac index. Endocrine function of the heart. External manifestations of cardiac activity (electrical, sound, mechanical). Regulation of heart activity (myogenic, humoral, nervous).</p>		
12	<p>The main hemodynamic parameters</p> <p>Structural and functional organization of the vascular system. The main hemodynamic parameters. Volumetric and linear velocity of blood movement in various parts of the circulatory system. The time of the complete blood circulation. Total peripheral vascular resistance. Blood pressure, its types. Factors that determine the value of blood pressure. Microcirculation and its role in the mechanism of fluid and various substances exchange between blood and tissues. Lymph formation and lymph circulation.</p>		1
13	<p><i>Control of vascular tone</i></p> <p>Vascular tone, myogenic and nervous control mechanism. The role of local metabolic factors in the regulation of vascular tone. Functional system of regulation of blood pressure in the body.</p>		1
14	<p><b>PHYSIOLOGY OF THE ENDOCRINE SYSTEM</b></p> <p>Glands of internal secretion. Research methods, classification of the endocrine glands. Hormones, their main signs, the physiological effect of hormones. Hypothalamic-pituitary system. The role of the endocrine glands in the general system of regulation of functions. The role of tissue hormones in the regulation of organs and tissues of the body.</p>		2
15	<p><b>PHYSIOLOGY OF RESPIRATION</b></p> <p>The main stages of breathing.</p> <p>External breathing. Biomechanics of inhalation and exhalation. Intrapleural pressure, its change during breathing. Lung ventilation, lung ventilation indicators. Gas exchange in the lungs. The composition of inhaled, exhaled and alveolar air. The relationship between blood flow and lung ventilation. Transportation of gases by blood. Hemoglobin, its forms. The content of O<sub>2</sub> and CO<sub>2</sub> in arterial and venous blood. Oxygen capacity of the blood. Formation and dissociation of bicarbonates and carbohemoglobin. The value of carbonic anhydrase. Gas exchange between blood and tissues.</p> <p>Control of breathing.</p> <p>An concept of the structure and function of the respiratory center. Nervous and humoral effects on the respiratory center. The reflexes of Goering and Breuer. The mechanisms of the first breath. Features of breathing in altered environmental conditions. Functional system of</p>		2

	respiratory regulation. Conditioned reflex and voluntary regulation of breathing.		
16	<p style="text-align: center;"><b>BLOOD PHYSIOLOGY</b></p> <p>The composition and functions of blood. Hemostasis. The doctrine of blood groups.  Blood, blood components, their physiological role The concept of hemostasis. Vascular-platelet hemostasis, coagulation hemostasis, fibrinolysis. Anticoagulation system. Anticoagulants, their classification and mechanisms of action. Coagulation, anticoagulation and fibrinolytic systems as the main reaction devices of the functional system that ensures the maintenance of the liquid state of the blood. Regulation of blood clotting.  ABO system, Rh system (Rh). The physiological basis of blood transfusion.</p>		2
17	<p style="text-align: center;"><b>PHYSIOLOGY OF DIGESTION</b></p> <p>Digestion, its meaning and types. Digestion in the oral cavity. Features of digestion in the stomach. Methods of study. Mechanisms of regulation. Digestion in the intestine. Methods of study. Mechanisms of regulation. The role of bile in digestion. Barrier function of the liver. Endocrine function of the digestive tract.</p>		2
18	<p style="text-align: center;"><b>PHYSIOLOGY OF EXCRETION</b></p> <p>The allocation system. The kidney as an excretory organ. Kidney functions. The nephron as a morphofunctional unit of the kidney.  Processes of urination: filtration, reabsorption, secretion.  Neurohumoral regulation of urination, the role of the nervous system and hormones (ADH, aldosterone, catecholamines, etc.). Functional system of water -salt homeostasis. Non-excretory kidney functions.</p>		2
<b>Total (всего – 88 АЧ)</b>		14	14

### 6.2.2. Thematic plan of laboratory practicum: not provided by GEF.

### 6.2.3. Thematic plan of practicals\*:

No.	Topics of practicals	Volume in academic hours (AH)	
		Semester 3	Semester 4
1	<p><b>Introduction to the subject "Normal physiology".</b>  <b>Physiology and biophysics of excitable systems. Biotopes.</b>  <b>The resting membrane potential.</b>  Practical work:  1. Preparation of neuromuscular preparation.  1. 1st Galvani experience.</p>	2 2	
2	<p><i>Biocurrents. Action potential. Conditions for the occurrence of excitation.</i>  1. Registration of nerve action currents.  2. Secondary tetanus (Matteucci's experience).  1. 3. Determination of nerve and muscle excitability.</p>	3	



3	<i>Factors determining the nature of the tissue response. The laws of irritation.</i> Practical work: 1. 1. Determination of the relationship between the strength of a single irritation and the magnitude of the tissue response (the law of force relations).	4	
4	<i>Physiology of muscles. Physiology of nerves.</i> Practical work: 1. Different types of muscle contractions	1	
5	Control lesson on the section "Physiology of excitable systems"	4	
6	<b>Regulation of physiological functions. Nervous and humoral mechanisms of regulation</b> Practical work: 1. Analysis of the reflex arc of the somatic reflex. 1. 2. Study of humoral effects on isolated heart models.	4	
7	<b>General physiology of the central nervous system (CNS).</b> Reflex. Physiology of synaptic transmission. Practical work: 1. 1. Determination of the dependence of the time and amplitude of the spinal reflex on the strength of irritation.	3	
8	<i>The nerve center. Features of excitation along the reflex arc.</i> 1. Investigation of the phenomenon of reflex afteraction. 2. Investigation of the phenomenon of irradiation of excitation in the central nervous system.	4	
9	<i>Inhibition in the central nervous system. General principles of coordination activity of the Central Nervous System.</i> Practical work: 1. 1. Investigation of the nature of the interaction of reflex acts (Golts' experience). 2.	4	
10	<i>Regulation of muscle tone</i> Practical work: 1. Investigation of the nature of spinal tone. 2. The study of setting-tonic reflexes	3	
11	Control lesson on the section "Physiology of the central nervous system".	4	
12	<b>Physiology of sensory systems. General properties of sensor systems</b> Practical work: 1. 1. Study of the phenomenon of adaptation of receptors.	3	
13	<i>Physiology of the auditory sensory system.</i> Practical work: 1. Determination of the frequency range perceived by a person.	3	
14	<i>Physiology of the visual sensory system.</i> Practical work:	2	

	1. The study of visual acuity. 2. Color vision research.		
15	<b>Physiology of higher nervous activity.</b> Conditioned reflexes, mechanisms of their formation and inhibition. Types of the higher nervous activity. Practical work: 1. Express diagnostics of strength and mobility of nervous processes by psychomotor indicators (tapping test)	2	
16	<b>Physiology of higher nervous activity</b> Physiology of sleep, memory, motivation, emotions Practical work: 1. Determination of the volume of short-term auditory memory. 1. 2. The study of logical thinking	2	
17	<b>Semester control</b>	2	
18	<b>Physiology of blood circulation</b> <i>Cardiac cycle. Physiological properties of the heart.</i> <i>Automation</i> Practical work: 1. Observation of the frog's cardiac cycle and graphical registration of heart contractions (cardiography). 2. Investigation of the automatics of the conductive system of the heart (superimposition of 1 and 2 Stannius ligatures). 3. Study of the automatism of the isolated heart.		5
19	<i>Physiological properties of the heart. Conductivity, excitability, contractility.</i> Practical work: 1. Study of the excitability of the heart muscle during the cardiac cycle (obtaining ventricular extrasystole).		5
20	<i>Control of cardiac activity.</i> Practical work: 1. Investigation of the influence of parasympathetic and sympathetic nerves on the cardiac activity of a frog. 2. The study of reflex effects on the activity of the heart.		2
21	<i>Physiology of blood circulation. The main indicators of hemodynamics.</i> Practical work: 1. Measurement of blood pressure in humans by the Riva-Rocci method. 2. Measurement of blood pressure in humans by the Korotkov method.		2
22	<i>Vascular tone, its regulation. The principle of systemic regulation of hemodynamics.</i> Practical work: 1. Study of the effect of physical activity on blood pressure and pulse characteristics. 2. Study of the influence of body position on the value of blood pressure.		4
23	Control lesson on the section "Physiology of the		5

	cardiovascular system".		
24	<b>Physiology of respiration.</b> <i>External breathing. Gas exchange in lungs and tissues.</i> <i>Transportation of gases by blood.</i> Practical work: 1. Spirometry. 1. 2. Control work on the transport of gases by blood		3
25	<i>Regulation of external respiration.</i> Practical work: 1. Spirography		1
26	<b>Blood physiology.</b> <i>Blood functions, blood composition, cell elements.</i> Practical work: 1. Determination of hemoglobin content in the blood by the Sali method. 1. 2. Calculation of the color index of blood.		2
27	<i>Hemostasis.</i> <i>Group-specific properties of blood.</i> Practical work: 1. Determination of the blood group according to the ABO system. 1. 2. Determination of Rh-belonging of blood by express method.		3
28	Control lesson on the section "Physiology of blood".		5
29	<b>Physiology of digestion.</b> Practical work: 1. Study of the effect of acetylcholine and adrenaline on intestinal motility. 2. Control work		5
30	<b>Physiology of excretion.</b> Practical work: 1. The study of diuresis in various conditions. 2. Control work.		5
31	<b>Physiology of metabolism. Thermoregulation.</b> Practical work: 1. Calculation of the main exchange. 2. Calculation of daily energy costs. 3. Preparation of the food ration.		3
32	<b>Semester control</b>		2
	Total	52	52
	Summa	104	

#### 6.2.4. Thematic plan of seminars: not provided by the Federal State Educational Standard.

#### 6.2.5. Types and topics of student's individual work (SIW)

No.	Types and topics of SIW	Volume in academic hours (AH)	
		Semester 3	Semester 3
1	Preparation for practical classes, homework, preparation for the current control	15	14
2	Working with lecture material, taking notes	8	8
3	Working with electronic resources on the portal of distance education I accept	6	6
4	Study of the material submitted for independent study, abstracting	5	6
5	Preparation for testing, online testing	4	4
6	Preparation for final classes	4	4
7	Total	<b>42</b>	<b>42</b>

### 6.7. Student's research work

No.	The name of the topics of the student's research work	Semester
1.	Features of cerebral circulation.	3,4
2.	Features of categorization of concrete and abstract words in the norm and prospects for use in medical research.	3,4
3.	Neurophysiological mechanisms of long-term memory.	3,4
4.	The study of mindfulness in the light of modern concepts of neurophysiology.	3,4
5.	Modeling of focal cerebral ischemia in rats using photo thrombosis.	3,4
6.	Prospects for the use of late evoked potentials of the human brain to assess its cognitive functions.	3,4
7.	Migraine.	3,4
8.	Does the brain know that it makes mistakes?	3,4
9.	Sensory-induced potentials in the go-no-go paradigm, motor-induced potentials associated with error.	3,4

### 7. Types of assessment formats for ongoing monitoring and mid-term assessment

No.	№ Semester	Forms of control	Name of the discipline section	Evaluation tools		
				Kinds	Number of questions in the task	Number of task options
1	2	3	4	5	6	7
1	3	Monitoring of mastering the topic	Introduction to the subject. Basic concepts of physiology. Regulation of physiological	Filling in tables	2	1
				Control questions	3	5
				A written report on the execution of practical works.	According to the plan of practical classes (п.6.4)	1

			functions.			
2	3	Monitoring of mastering the topic	Physiology of excitable systems.	Test tasks	10	20 (testing on paper) 2 (computer testing on DES)
					25	
				Control questions	4	7
				Situational tasks	1-3	9
				Completing tasks (tables, graphs, figures)	9	1
A written report on the execution of practical works	According to the plan of practical classes (п.6.4)	1				
3	3	Monitoring of mastering the topic	Physiology of the central nervous system (CNS).	Test tasks	10	20 (testing on paper) 2 (computer testing on DES)
					25	
				Control questions	4	7
				Situational tasks	1-3	7
				Completing tasks (tables, graphs, figures)	7	1
A written report on the execution of practical works.	According to the plan of practical classes (п.6.4)	1				
4	3	Monitoring of mastering the topic	Physiology of the endocrine system.	Referencing of the textbook and additional literature.		
5	4	Monitoring of mastering the topic	Blood Physiology.	Test tasks	10	20 (testing on paper) 2 (computer testing on DES)
					25	
				Control questions	4	7
				Situational tasks	1-3	7
				Completing tasks (tables, graphs, figures)	2	1
A written report on the execution of practical works	According to the plan of practical classes (п.6.4)	1				
6	4	Monitoring of mastering the topic	Physiology of respiration.	Control questions	3	5
				Situational tasks	2-3	3
				A written report on the execution of practical works.	According to the plan of practical classes (п.6.4)	1

7	4	Monitoring of mastering the topic	Metabolic bases of physiological functions. Physiology of thermoregulation.	Control questions	3	5
				Situational tasks	1	3
				A written report on the execution of practical works.	According to the plan of practical classes (п.6.4)	1
8	4	Monitoring of mastering the topic	Physiology of excretion.	Control questions	3	5
				Situational tasks	1-2	4
				Completing tasks (tables, graphs, figures)	1	1
				A written report on the execution of practical works.	According to the plan of practical classes (п.6.4)	1
9	4	Monitoring of mastering the topic	Physiology of digestion.	Control questions	3	5
				Situational tasks	1-2	3
				A written report on the execution of practical works.	According to the plan of practical classes (п.6.4)	1
10	4	Monitoring of mastering the topic	Physiology of circulation	Test tasks	10 25	20 (testing on paper) 2 (computer testing on DES))
				Control questions	4	9
				Situational tasks	1-2	4
				Completing tasks (tables, graphs, figures)	7	1
				A written report on the execution of practical works.	According to the plan of practical classes (п.6.4)	1
11	3	Monitoring of mastering the topic	Physiology of sensory systems.	Control questions	3	9
				Situational tasks	1-3	6
				Completing tasks (tables, graphs, figures)	2	1
				A written report on the execution of practical works.	According to the plan of practical classes (п.6.4)	1
12	3	Monitoring of mastering the topic	Physiology of higher nervous activity..	Control questions	2	10
				Situational tasks	1-3	6
				A written report on the execution of practical works.	According to the plan of practical classes (п.6.4)	1

13	4	Monitoring of mastering the topic	Physiology of functional states.	Referencing of the textbook and additional literature.		
14	3	Monitoring of mastering the topic	Physiology of excitable systems; Central Nervous System Physiology; Physiology of the endocrine system. Physiology of sensory systems; The physiology of pain.	Test tasks	20	Computer testing (the variant is formed by random sampling)
15	4	Monitoring of mastering the topic	Blood Physiology; Physiology of respiration; Metabolic bases of physiological functions. Thermoregulation; Physiology of excretion; Physiology of digestion. Physiology of blood circulation; Physiology of higher nervous activity Physiology of functional states.	Test tasks	20	Computer testing (the variant is formed by random sampling)
16	4	Intermediate certification (exam)	All sections	Test tasks	50	Computer testing (the variant is formed by random sampling)
				Ticket interview	4	

## 8. Educational, methodological and information support for mastering the academic discipline (printed, electronic publications, the Internet and other network resources)

### 8.1. Key literature references

No.	Name according to bibliographic requirements	Number of copies	
		At the department	In the library
1.	1. Costanzo, Linda S. Physiology / L.S. Costanzo; Costanzo, Linda S. - 6th ed. - Philadelphia: Elsevier, 2018. - 516 p		

2.	2. Hall, John E. Textbook of medical physiology / J.E. Hall, A.C. Guyton; Hall, John E. ; Guyton, Arthur C. - 13th ed. - Philadelphia: Elsevier, 2016. - 1145 p.	2	150
3.	Нормальная физиология [Электронный ресурс]: учебник / под ред. К.В. Судакова. - М.: ГЭОТАР-Медиа, 2015. - <a href="http://www.studmedlib.ru">http://www.studmedlib.ru</a> .		

## 8.2. Further reading

No.	Name according to bibliographic requirements	Number of copies	
		At the department	In the library
1.	Shier, D. Hole`s essentials of human anatomy & physiology / D. Shier, J. Butler, R. Lewis; Shier, D.; Butler, J. ; Lewis, Ricki. - 12th ed. - New York: McGraw-Hill Education, 2015. - 632 p.: il.		1
2.	6. Waugh, Anne. Ross and Wilson anatomy and physiology in health and illness / A. Waugh, A. Grant; Waugh, Anne; Grant, A. - 12th ed.- Edinburgh: Churchill Livingstone, 2014. - 509 p.		1
3.	7. Silbernagl, S. Color atlas of physiology / S. Silbernagl, A. Despopoulos. - 6th ed. - Stuttgart: Thieme, 2009. - 441 с		1
4.	Гайтон, А. К. Медицинская физиология: учебник для студентов высших учебных заведений / А. К. Гайтон, Д. Э. Холл. – М.: Логосфера, 2008. – 1256 с : ил.	1	11
5.	Холл Дж. Э. Медицинская физиология по Гайтону и Холлу: учебник/ Д. Э. Холл, А. К. Гайтон ; ред. В. И. Кобрин, М. М. Галагудза, А. Е. Умрюхин. – 2-е изд., испр. и доп. – М. : Логосфера, 2018. – 1328 с. : ил.		1
6.	Гайтон, А. К. Медицинская физиология [Электронный ресурс]: учебник для студентов высших учебных заведений: пер. с англ. / А. К. Гайтон, Д. Э. Холл. – М.: Логосфера, 2008. – 1256 с. – Режим доступа: <a href="http://books-up.ru/product/41471">http://books-up.ru/product/41471</a> . - С компьютеров академии доступ свободный. Для доступа с других IP-адресов требуются логин и пароль (доступны зарегистрированным пользователям в ЭБС академии).		1
7.	Физиология человека : атлас динамических схем / К. В. Судаков, В. В. Андрианов, Ю. Е. Вагин, И. И. Киселев; ред. К. В. Судаков. – 2-е изд., испр. и доп. – М.: ГЭОТАР-Медиа, 2015. – 416 с.		1
8.	Физиология человека: Атлас динамических схем [Электронный ресурс]: учебное пособие / К.В. Судаков, В.В. Андрианов, Ю.Е. Вагин, И.И. Киселев. - 2-е изд., испр. и доп. - М: ГЭОТАР-Медиа, 2015. - <a href="http://www.studmedlib.ru">http://www.studmedlib.ru</a>		
9.	Мухина, И.В. Физиология дыхания: учебное пособие / И. В. Мухина, О. А. Горева, В. А. Плеханов, Нижегородская государственная медицинская академия. – 5-е изд., доп. и перераб. – Н.Новгород: Изд-во НижГМА, 2014. – 60 с. : ил.	60	5



10.	Нормальная физиология [Электронный ресурс]: учебник для студентов мед. вузов / ред. В. М. Смирнов. – Электрон. дан. (422 Мб). – М.: Академия, 2010. – (Высшее профессиональное образование). – Режим доступа: <a href="http://95.79.46.206/view.php?fDocumentId=1117">http://95.79.46.206/view.php?fDocumentId=1117</a> .		
11.	Камкин, А.Г Атлас по физиологии: в двух томах / А. Г. Камкин, И. С. Киселева. – М.: ГЭОТАР-Медиа. ISBN 978-5-9704159-6-2. Камкин, А.Г Т.2: Атлас по физиологии / А. Г. Камкин, И. С. Киселева. – М.: ГЭОТАР-Медиа, 2012. – 448 с. : ил.		1 2
12.	Сборник тестовых и ситуационных задач по курсу «Нормальная физиология»: Учебное пособие для студентов медицинских вузов/ ред. И.В. Мухиной, <b>В.А. Плеханова</b> . - Н. Новгород: Изд-во НижГМА, 2013. – 198 с.: ил.	50	1
13.	Избранные вопросы по курсу "Нормальная физиология": учебно-методическое пособие / И. В. Мухина [и др.]; ред. И. В. Мухина. – Н.Новгород : Изд-во НижГМА, 2011. – 52 с.	10	3
14.	Избранные вопросы по курсу "Нормальная физиология" [Электронный ресурс]: учебно-методическое пособие / И. В. Мухина [и др.], Нижегородская государственная медицинская академия; под ред. И. В. Мухина. – Электрон. дан. (1 Мб). – Н. Новгород: Изд-во НижГМА, 2011. – Режим доступа: <a href="http://95.79.46.206/view.php?fDocumentId=2873">http://95.79.46.206/view.php?fDocumentId=2873</a> .		

### 8.3. List of guidelines for classroom and independent work of students

No.	Name according to bibliographic requirements	Number of copies	
		At the department	In the library
1.	PHYSIOLOGY PRACTICAL MANUAL / I.V. Mukhina et al. - N. Novgorod: Publishing House of PIMU, 2020. – 165 p.: il.	5	5

## 8.4. Electronic educational resources used in the process of teaching the discipline:

### 8.4.1. Internal Electronic Library System of the University (IELSU)

Name of the electronic resource	Brief description (content)	Access conditions	Number of users
Internal Electronic Library system of the University (In ELS) <a href="http://nbk.pimunn.net/MegaPro/Web">http://nbk.pimunn.net/MegaPro/Web</a>	Works of the teaching staff of the University: textbooks, textbooks, collections of tasks, methodological manuals, laboratory work, monographs, collections of scientific papers, scientific articles, dissertations, abstracts of dissertations, patents	From any computer and mobile device using an individual login and password. Access mode: <a href="http://nbk.pimunn.net/MegaPro/Web">http://nbk.pimunn.net/MegaPro/Web</a>	Not limited

### 8.4.2. Electronic educational resources acquired by University

No.	Name of the electronic resource	Brief description (content)	Access conditions	Number of users
1.	EBS "Student Consultant" (Electronic database "Student Consultant". Database "Medicine. Healthcare (VO) and "Medicine. Healthcare (SPO)") <a href="http://www.studmedlib.ru">http://www.studmedlib.ru</a>	Educational literature, additional materials (audio, video, interactive materials, test tasks) for higher medical and pharmaceutical education	From any computer and mobile device using an individual login and password. Access mode: <a href="http://nbk.pimunn.net/MegaPro/Web">http://nbk.pimunn.net/MegaPro/Web</a>	
2.	Database "Doctor's consultant. Electronic Medical Library" <a href="https://www.rosmedlib.ru">https://www.rosmedlib.ru</a>	National guidelines, clinical guidelines, textbooks, monographs, atlases, pharmaceutical reference books, audio and video materials, ICD-10 and ATX	From any computer and mobile device using an individual login and password. Access mode: <a href="http://nbk.pimunn.net/MegaPro/Web">http://nbk.pimunn.net/MegaPro/Web</a>	Not limited  Validity period: until 31.12.2021
3.	Electronic library system "Bukap" <a href="https://www.books-up.ru">https://www.books-up.ru</a>	Educational and scientific medical literature of Russian publishers, including translations of foreign publications. Within the framework of the "Big Medical Library" project, publications of universities participating in the project are available	From any computer and mobile device using an individual login and password; access is automatic from university computers. Publications from the "My Books" section are available for reading. Access mode: <a href="http://nbk.pimunn.net/MegaPro/Web">http://nbk.pimunn.net/MegaPro/Web</a>	Not limited  Validity period: until 31.05.2022
4.	Electronic periodicals as part of the database "Scientific Electronic Library ELibrary" <a href="https://elibrary.ru">https://elibrary.ru</a>	Electronic medical journals	From university computers. Access mode: <a href="https://elibrary.ru">https://elibrary.ru</a>	Not limited  Validity period: until 31.12.2021
5.	Integrated Information and Library system (IBS) of the scientific and educational medical cluster of the Volga Federal District - "Srednevolzhsky" (contract on a free basis)	Electronic copies of scientific and educational publications from the collections of libraries participating in the scientific and educational medical cluster of the Volga Federal District "Srednevolzhsky"	Access by individual login and password from any computer and mobile device. Access mode: websites of libraries participating in the project	Not limited  Validity period: Not limited
6.	National Electronic Library (NEB) (contract on a free basis) <a href="http://нэб.рф">http://нэб.рф</a>	Electronic copies of publications (including scientific and	Scientific and educational works that have not been reprinted in the last 10 years	Not limited  Validity period:

		educational) on a wide range of knowledge	are in the public domain. Works restricted by copyright – from the computers of the scientific library. Access mode: <a href="http://HЭБ.рф">http://HЭБ.рф</a>	Not limited
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### 8.4.3 Open access resources

No.	Name of the electronic resource	Brief description (content)	Access conditions	Number of users
Domestic resources				
1.	Federal Electronic Medical Library (FEMB) <a href="http://HЭБ.рф">http://HЭБ.рф</a>	Full-text electronic copies of printed publications and original electronic publications on medicine and biology	From any computer located on the Internet. Access mode: <a href="http://HЭБ.рф">http://HЭБ.рф</a>	Not limited
2.	Scientific Electronic Library eLIBRARY.RU <a href="https://elibrary.ru">https://elibrary.ru</a>	Abstracts and full texts of scientific publications, electronic versions of Russian scientific journals	From any computer located on the Internet. Access mode: <a href="https://elibrary.ru">https://elibrary.ru</a>	Not limited
3.	Open Access Scientific Electronic Library CyberLeninka <a href="http://cyberleninka.ru">http://cyberleninka.ru</a>	Full texts of scientific articles with annotations published in scientific journals of Russia and neighboring countries	From any computer located on the Internet. Access mode: <a href="https://cyberleninka.ru">https://cyberleninka.ru</a>	Not limited
Foreign resources within the framework of a National subscription				
1.	Electronic collection of the publishing house Springer <a href="https://rd.springer.com">https://rd.springer.com</a>	Full-text scientific publications (journals, books, articles, scientific protocols, conference materials)	From university computers. Access mode: <a href="https://rd.springer.com">https://rd.springer.com</a>	Not limited

## 9. Material and technical support for mastering an academic discipline

### 9.1. List of premises for classroom activities for the discipline

1. A large lecture hall of the Building 2., equipped with multimedia equipment and a microphone.

2. Classrooms № 301, 302, 303, 305, 312, 318 BFC for practical classes, consultations, current control and intermediate certification, independent work of students with the ability to connect to the Internet to provide access to the electronic library "PIMU".

3. Computer class (testing center) for conducting test control, with the ability to connect to the Internet, conducting independent work and providing access to the PIMU electronic library.

### 9.2. List of equipment for classroom activities for the discipline

No.	Name	Purpose	Quantity (unit)
1.	Epson EB-X72 multimedia equipment; laptop (Office Professional Plus 2010, Windows Starter <a href="https://www.microsoft.com/Licensing/servicecenter/LicensingSummary/Summary.aspx">https://www.microsoft.com/Licensing/servicecenter/LicensingSummary/Summary.aspx</a> Kaspersky Endpoint Security Russian Edition. 150-	Lecturing	1 1

	249Node 1 year Educational Renewal License № 1150170421101518337264)		
2.	Polygraph BIOPAC MP 30B-CE (Biopac Student Lab 3.7.1 s/n2029; Biopac Student Lab Pro 3.7.1 s/n2029)	Demonstration of methods and results of instrumental studies of physiological functions	1
3.	Oscilloscope C1-18	Use in an experiment to study the biophysical properties of excitable biosystems.	1
4.	Amplifier of potentials 203	Use in an experiment to study the biophysical properties of excitable biosystems.	1
5.	Electrostimulator ЭСЛ-2	Use in an experiment to study the biophysical properties of excitable biosystems	1
6.	Projector Оверхед Вера	Slide show.	1
7.	Electroreflexometer	Investigation of reflex time	1
8.	Electrokimographs	Registration of myogram, cardiogram	5
9.	Electrical stimulator NS-Steem -1	Use in an experiment to study the biophysical properties of excitable biosystems	5
10.	Induction Coils	Use in an experiment to study the biophysical properties of excitable biosystems, the activity of the central nervous system, the heart.	5
11.	Transformers	Use in an experiment to study the biophysical properties of excitable biosystems, the activity of the central nervous system, heart, digestive system.	5
12.	Electrocardiograph EK1T-1/3-07	ECG registration	10
14.	Atemi ALLURE Exercise bikes	Study of the effect of stress tests on the cardiorespiratory system	5
15.	Bicycle ergometers VE-05	Study of the effect of stress tests on the cardiorespiratory system	2
16.	Tonometers	Blood pressure measurement	25
17.	OMRON RX-3 tonometers	Blood pressure measurement	2
18.	Monocular microscopes	Study of tissue structure	7
19.	Sali hemometers	Measurement of the amount of hemoglobin in the blood	14
20.	Rabkin Tables	Definition of color vision	8
21.	Sound Frequency generator	Determination of the range of sound frequencies perceived by a person.	1
22.	Infrared Thermometers Sam	Body temperature measurement	5
23.	Thermal imager personal Sem	Body temperature study	1
24.	Computers (Office Professional Plus 2010, Windows Starter <a href="https://www.microsoft.com/Licensing/servicecenter/">https://www.microsoft.com/Licensing/servicecenter/</a> )	Processing of scientific and educational information.	5

	LicensingInfo/LicenseSummary/Summary.aspx Kaspersky Endpoint Security Russian Edition. 150-249Node 1 year Educational Renewal License № 1150170421101518337264)		
25.	Testing Center computers (Office 2010, Windows 7 <a href="https://www.microsoft.com/Licensing/servicecenter/LicensingInfo/LicenseSummary/Summary.aspx">https://www.microsoft.com/Licensing/servicecenter/LicensingInfo/LicenseSummary/Summary.aspx</a> Testing program on the platform Moodle <a href="https://moodle.org/?lang=ru">https://moodle.org/?lang=ru</a> )	Conducting an intermediate test control, with the possibility of connecting to the Internet, for independent work and providing access to the PIM electronic library	16
26.	Surgical instruments	Use in experiments on the topics: "Physiology of excitable biosystems", "Physiology of the central nervous system", "Physiology of the cardiovascular system", "Physiology of digestion".	

**10. List of changes to the working program «Normal physiology»**

Federal State Budgetary Educational Institution of Higher Education  
"Privolzhsky Research Medical University"  
Ministry of Health of the Russian Federation  
(FSBEI HE "PRMU" of the Ministry of Health of Russia)

Department of  
Normal Physiology named after N.Yu. Belenkov

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**CHANGE REGISTRATION SHEET**

working program for the academic discipline  
***NORMAL PHYSIOLOGY***

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Field of study / specialty / scientific specialty: \_\_\_\_\_ **GENERAL MEDICINE (31.05.01)**  
(code, name)

Training profile: \_\_\_\_\_  
(name) - for master's degree programs

Mode of study: \_\_\_\_\_ full-time \_\_\_\_\_  
full-time/mixed attendance mode/extramural

Position	Number and name of the program section	Contents of the changes made	Effective date of the changes	Contributor's signature
1	p.6.2, 6.4	To change the order of practical classes and lectures in the autumn semester of the 2021-2022 academic year – p.6.2, 6.4 (Appendix 1)	30.08.2021	Volkova I.F.
2	p. 8.1, 8.2	Corrections in lists of literature 8.1 "List of basic literature" and 8.2 "List of additional literature" (Appendix 3)	29.08.2022	Volkova I.F.
3	p. 3	Make changes to the "Be able" and "Own" sections of paragraph 3 (Appendix 2)	29.08.2022	Volkova I.F.

Approved at the department meeting  
Protocol No. \_\_\_\_\_ of \_\_\_\_\_ 20\_\_

Head of the Department of Normal Physiology  
named after N.Yu. Belenkov, PhD, DrSci, Prof. \_\_\_\_\_ / Mukhina I.V.  
signature

## Appendix 1

### 6.2. Thematic plan of lectures:

No.	Name of lecture topics	Volume in academic hours (AH)	
		Semester 3	Semester 4
1	<p><b>INTRODUCTION TO PHYSIOLOGY. PHYSIOLOGY AND BIOPHYSICS OF EXCITABLE TISSUES</b></p> <p>Introduction to physiology, connection of physiology with medical sciences. Tasks of physiology, modern problems and development trends. Basic concepts of physiology.</p> <p>The doctrine of biological flows. Resting membrane potential. The potential of action, its nature.</p>	0,5	
	<p>Bioelectric phenomena in excitable systems.</p> <p>The doctrine of biological currents. Currents of rest and action. Resting membrane potential. Membrane-ion theory of rest potential formation and methods of its registration. The potential of an action, its phases, their origin.</p>	1,5	
2	<p>Conditions for the occurrence of excitation. The laws of irritation.</p> <p>General properties of excitable systems.</p> <p>The dependence of the nature of the response of the biosystem on its functional state and on the parameters of the active irritation (the laws of irritation). Change in excitability in the process of excitation. Optimal and pessimal reactions. Lability as a property of excitable biosystems.</p>	1	
3	<p><b>PHYSIOLOGY OF THE CENTRAL NERVOUS SYSTEM (CNS)</b></p> <p>Physiology of the synapse. Neurotransmitters and neuromodulators. Nerve centers. Features of excitation in the central nervous system (unilateral conduction, central delay, spatial and temporal summation, transformation of the excitation rhythm, post-tetanic potentiation).</p>	1	
4	<p>Inhibition in the central nervous system. General principles of CNS coordination activity</p> <p>Concepts of inhibition in the central nervous system. The importance of inhibition. Mechanisms and types of inhibition. Principles of reciprocity, feedback, facilitation, occlusion, path tracing, common end path, dominance, hierarchy of multilevel regulation.</p>	2	
5	<p><b>MUSCLE TONE</b></p> <p>Types of tone (spinal, contractile and plastic tone), mechanisms of regulation.</p>	1	
6	<p><b>PHYSIOLOGY OF THE AUTONOMIC NERVOUS SYSTEM.</b></p> <p>Sympathetic, parasympathetic and metasymphathetic divisions of the ANS, their structural and functional differences. The problem of regulation of vegetative functions in the body.</p>	1	
7	<p><b>PHYSIOLOGY OF SENSORY SYSTEMS</b></p> <p>The concept of sensory systems. Psychology of perception. The principles of the organization of sensor systems are multilayered,</p>	1	



	multilevel, multi-channel, bi-hemispheric. Sensory receptors, their physiological properties. Signal detection. Encoding of information in the peripheral department of analyzers.		
8	<p style="text-align: center;"><b>PHYSIOLOGY OF HIGHER NERVOUS ACTIVITY</b></p> <p>Conditioned reflex, conditions of its formation and inhibition. Physiology of memory, motivations and emotions, sleep.</p>	1	
9	<p style="text-align: center;"><b>CONTROL OF PHYSIOLOGICAL FUNCTIONS</b></p> <p>Levels of structural and functional organization of the organism. Homeostasis and homeokinesis. Basic principles, methods and mechanisms of regulation of functions.</p> <p>Types of humoral regulation (autocrine, paracrine, endocrine). Glands of internal secretion. Hormones, their main signs, the physiological effect of hormones. Hypothalamic-pituitary system. The role of the endocrine glands in the general system of regulation of functions. The role of tissue hormones in the regulation of organs and tissues of the body.</p> <p>Nervous regulation. Principles of Sechenov-Pavlov reflex theory. Feedback.</p> <p>The concept of self-regulation. Theory of functional systems by P.K. Anokhin.</p>	2	
10	<p style="text-align: center;"><b>THE PHYSIOLOGY OF PAIN.</b></p> <p>Components of pain. Classification of pain. Nociceptive and antinociceptive systems.</p>	2	
11	<p style="text-align: center;"><b>PHYSIOLOGY OF BLOOD CIRCULATION</b></p> <p style="text-align: center;">Physiological properties of the heart.</p> <p>The value of blood circulation. Morphological characteristics and physiological properties of the heart muscle (excitability, conductivity, contractility, automatism). The conducting system of the heart, its functional features.</p> <p style="text-align: center;">Regulation of cardiac activity</p> <p>Pumping function of the heart. Systolic and minute blood volumes, cardiac index. Endocrine function of the heart. External manifestations of cardiac activity (electrical, sound, mechanical). Regulation of heart activity (myogenic, humoral, nervous).</p>		2
12	<p style="text-align: center;">The main hemodynamic parameters</p> <p>Structural and functional organization of the vascular system. The main hemodynamic parameters. Volumetric and linear velocity of blood movement in various parts of the circulatory system. The time of the complete blood circulation. Total peripheral vascular resistance. Blood pressure, its types. Factors that determine the value of blood pressure. Microcirculation and its role in the mechanism of fluid and various substances exchange between blood and tissues. Lymph formation and lymph circulation.</p>		1
13	<p style="text-align: center;"><i>Control of vascular tone</i></p> <p>Vascular tone, myogenic and nervous control mechanism.</p>		1

	The role of local metabolic factors in the regulation of vascular tone. Functional system of regulation of blood pressure in the body.		
14	<p style="text-align: center;"><b>PHYSIOLOGY OF THE ENDOCRINE SYSTEM</b></p> <p>Glands of internal secretion. Research methods, classification of the endocrine glands. Hormones, their main signs, the physiological effect of hormones. Hypothalamic-pituitary system. The role of the endocrine glands in the general system of regulation of functions. The role of tissue hormones in the regulation of organs and tissues of the body.</p>		2
15	<p style="text-align: center;"><b>PHYSIOLOGY OF RESPIRATION</b></p> <p style="text-align: center;">The main stages of breathing.</p> <p>External breathing. Biomechanics of inhalation and exhalation. Intrapleural pressure, its change during breathing. Lung ventilation, lung ventilation indicators. Gas exchange in the lungs. The composition of inhaled, exhaled and alveolar air. The relationship between blood flow and lung ventilation. Transportation of gases by blood. Hemoglobin, its forms. The content of O<sub>2</sub> and CO<sub>2</sub> in arterial and venous blood. Oxygen capacity of the blood. Formation and dissociation of bicarbonates and carbohemoglobin. The value of carbonic anhydrase. Gas exchange between blood and tissues.</p> <p style="text-align: center;">Control of breathing.</p> <p>An concept of the structure and function of the respiratory center. Nervous and humoral effects on the respiratory center. The reflexes of Goering and Breuer. The mechanisms of the first breath. Features of breathing in altered environmental conditions. Functional system of respiratory regulation. Conditioned reflex and voluntary regulation of breathing.</p>		2
16	<p style="text-align: center;"><b>BLOOD PHYSIOLOGY</b></p> <p>The composition and functions of blood. Hemostasis. The doctrine of blood groups.</p> <p>Blood, blood components, their physiological role The concept of hemostasis. Vascular-platelet hemostasis, coagulation hemostasis, fibrinolysis. Anticoagulation system. Anticoagulants, their classification and mechanisms of action. Coagulation, anticoagulation and fibrinolytic systems as the main reaction devices of the functional system that ensures the maintenance of the liquid state of the blood. Regulation of blood clotting.</p> <p>ABO system, Rh system (Rh). The physiological basis of blood transfusion.</p>		2
17	<p style="text-align: center;"><b>PHYSIOLOGY OF DIGESTION</b></p> <p>Digestion, its meaning and types. Digestion in the oral cavity. Features of digestion in the stomach. Methods of study. Mechanisms of regulation. Digestion in the intestine. Methods of study. Mechanisms of regulation. The role of bile in digestion. Barrier function of the liver. Endocrine function of the digestive tract.</p>		2

18	<p style="text-align: center;"><b>PHYSIOLOGY OF EXCRETION</b></p> <p>The allocation system. The kidney as an excretory organ. Kidney functions. The nephron as a morphofunctional unit of the kidney. Processes of urination: filtration, reabsorption, secretion. Neurohumoral regulation of urination, the role of the nervous system and hormones (ADH, aldosterone, catecholamines, etc.). Functional system of water -salt homeostasis. Non-excretory kidney functions.</p>		2
<b>Total (88 AH)</b>		14	14

#### 6.4. Thematic plan of practical classes:

No.	Topics of practicals	Volume in academic hours (AH)	
		Semester 3	Semester 3
1	<p><b>Introduction to the subject "Normal physiology".</b></p> <p><b>Physiology and biophysics of excitable systems. Biotopes. The resting membrane potential.</b></p> <p>Practical work:</p> <ol style="list-style-type: none"> <li>1. Preparation of neuromuscular preparation.</li> <li>2. 1st Galvani experience.</li> </ol>	2 2	
2	<p><i>Biocurrents. Action potential. Conditions for the occurrence of excitation.</i></p> <ol style="list-style-type: none"> <li>1. Registration of nerve action currents.</li> <li>2. Secondary tetanus (Matteucci's experience).</li> <li>3. Determination of nerve and muscle excitability.</li> </ol>	3	
3	<p><i>Factors determining the nature of the tissue response. The laws of irritation.</i></p> <p>Practical work:</p> <ol style="list-style-type: none"> <li>1. Determination of the relationship between the strength of a single irritation and the magnitude of the tissue response (the law of force relations).</li> </ol>	4	
4	<p><i>Physiology of muscles. Physiology of nerves.</i></p> <p>Practical work:</p> <ol style="list-style-type: none"> <li>1. Different types of muscle contractions</li> </ol>	1	
5	Control lesson on the section "Physiology of excitable systems"	4	
6	<p><b>General physiology of the central nervous system (CNS).</b></p> <p>Reflex. Physiology of synaptic transmission.</p> <p>Practical work:</p> <ol style="list-style-type: none"> <li>1. Determination of the dependence of the time and amplitude of the spinal reflex on the strength of irritation.</li> </ol>	3	
7	<p><i>The nerve center. Features of excitation along the reflex arc.</i></p> <ol style="list-style-type: none"> <li>1. Investigation of the phenomenon of reflex afteraction.</li> <li>2. Investigation of the phenomenon of irradiation of excitation in the central nervous system.</li> </ol>	4	
8	<i>Inhibition in the central nervous system. General principles of</i>	4	

	<i>coordination activity of the Central Nervous System.</i> Practical work: 1. Investigation of the nature of the interaction of reflex acts (Golts' experience).		
9	<i>Regulation of muscle tone</i> Practical work: 1. Investigation of the nature of spinal tone. 2. The study of setting-tonic reflexes	3	
10	Control lesson on the section "Physiology of the central nervous system".	4	
11	<b>Physiology of sensory systems. General properties of sensor systems</b> Practical work: 2. 1. Study of the phenomenon of adaptation of receptors.	3	
12	<i>Physiology of the auditory sensory system.</i> Practical work: 1. Determination of the frequency range perceived by a person.	3	
13	<i>Physiology of the visual sensory system.</i> Practical work: 1. The study of visual acuity. 2. Color vision research.	2	
14	<b>Physiology of higher nervous activity.</b> Conditioned reflexes, mechanisms of their formation and inhibition. Types of the higher nervous activity. Practical work: 2. Express diagnostics of strength and mobility of nervous processes by psychomotor indicators (tapping test)	2	
15	<b>Physiology of higher nervous activity</b> Physiology of sleep, memory, motivation, emotions Practical work: 1. Determination of the volume of short-term auditory memory. 2. The study of logical thinking	2	
16	<b>Regulation of physiological functions. Nervous and humoral mechanisms of regulation</b> Practical work: 1. Analysis of the reflex arc of the somatic reflex. 2. Study of humoral effects on isolated heart models.	4	
17	<b>Semester control</b>	2	
18	<b>Physiology of blood circulation</b> <i>Cardiac cycle. Physiological properties of the heart. Automation</i> Practical work: 1. Observation of the frog's cardiac cycle and graphical registration of heart contractions (cardiography). 2. Investigation of the automatics of the conductive system of the heart (superimposition of 1 and 2 Stannius ligatures). 3. Study of the automatism of the isolated heart.		5
19	<i>Physiological properties of the heart. Conductivity, excitability, contractility.</i>		5

	<p>Practical work:</p> <p>1. Study of the excitability of the heart muscle during the cardiac cycle (obtaining ventricular extrasystole).</p>		
20	<p><i>Control of cardiac activity.</i></p> <p>Practical work:</p> <p>1. Investigation of the influence of parasympathetic and sympathetic nerves on the cardiac activity of a frog.</p> <p>2. The study of reflex effects on the activity of the heart.</p>		2
21	<p><i>Physiology of blood circulation. The main indicators of hemodynamics.</i></p> <p>Practical work:</p> <p>1. Measurement of blood pressure in humans by the Riva-Rocci method.</p> <p>2. Measurement of blood pressure in humans by the Korotkov method.</p>		2
22	<p><i>Vascular tone, its regulation. The principle of systemic regulation of hemodynamics.</i></p> <p>Practical work:</p> <p>1. Study of the effect of physical activity on blood pressure and pulse characteristics.</p> <p>2. Study of the influence of body position on the value of blood pressure.</p>		4
23	<p>Control lesson on the section "Physiology of the cardiovascular system".</p>		5
24	<p><b>Physiology of respiration.</b></p> <p><i>External breathing. Gas exchange in lungs and tissues. Transportation of gases by blood.</i></p> <p>Practical work:</p> <p>1. Spirometry.</p> <p>2. Control work on the transport of gases by blood</p>		3
25	<p><i>Regulation of external respiration.</i></p> <p>Practical work:</p> <p>1. Spirography</p>		1
26	<p><b>Blood physiology.</b></p> <p><i>Blood functions, blood composition, cell elements.</i></p> <p>Practical work:</p> <p>1. Determination of hemoglobin content in the blood by the Sali method.</p> <p>2. Calculation of the color index of blood.</p>		2
27	<p><i>Hemostasis.</i></p> <p><i>Group-specific properties of blood.</i></p> <p>Practical work:</p> <p>1. Determination of the blood group according to the ABO system.</p> <p>2. Determination of Rh-belonging of blood by express method.</p>		3
28	<p>Control lesson on the section "Physiology of blood".</p>		5
29	<p><b>Physiology of digestion.</b></p>		5

	Practical work: 1. Study of the effect of acetylcholine and adrenaline on intestinal motility. 2. Control work		
30	<b>Physiology of excretion.</b> Practical work: 1. The study of diuresis in various conditions. 2. Control work.		5
31	<b>Physiology of metabolism. Thermoregulation.</b> Practical work: 1. Calculation of the main exchange. 2. Calculation of daily energy costs. 3. Preparation of the food ration.		3
32	<b>Semester control</b>		2
	Total	52	52
	Total	104	

## Appendix 2

No.	Competence code	The content of the competence (or part thereof)	The code and name of the indicator of competence achievement	As a result of studying the discipline, students should:		
				Know	Be Able	Master
1.	UC -1	He is able to carry out a critical analysis of problem situations based on a systematic approach, to develop a strategy of actions	ИУК 1.1 Knows: methods of critical analysis and evaluation of modern scientific achievements; basic principles of critical analysis ИУК 1.2 Can: acquire new knowledge based on analysis, synthesis, etc.; collect data on complex scientific problems related to the professional field; search for information and solutions based on actions, experiment and experience.	Principles of analysis and evaluation of physiological processes occurring in human organs and systems; Principles of analysis and evaluation of functional systems of the human body and their self-regulation under the influence of factors of internal and external environment; Principles of analysis and evaluation of the results of functional and laboratory diagnostic methods (ECG, pulse and blood pressure research methods, spirometry, methods of research of sensory systems, higher nervous activity thermometry, hematological studies); Principles of analysis and evaluation of experimental results.	Measure blood pressure by the Korotkov method; Palpate the arterial pulse and determine its characteristics: Analyze the functional state of various cellular, tissue and organ structures; Analyze the functional systems of the human body and their self-regulation under the influence of factors of the internal and external environment; Analyze the results of laboratory and functional diagnostic methods; Analyze the results of practical work, draw conclusions corresponding to the set goal and the results of experiments	Skills of independent use of physiological functions of the conceptual apparatus.
4.	GPC -5	Able to assess morphofunctional, physiological states and pathological processes in the human body to solve professional tasks	ИОПК-5.1 Knows: anatomy, histology, embryology, topographic anatomy, physiology, pathological anatomy and physiology of human organs and systems ИОПК 5.2 Able to: evaluate the basic morphofunctional data, physiological states and pathological processes in the human body.	Physiological terms; General physiological patterns underlying the processes occurring in the human body; Physiological processes occurring in human organs and systems and their dynamics in different age periods; Functional systems of the human body, their regulation and self-regulation under the influence of factors of internal and external environment; Methods of functional and laboratory diagnostics (ECG, methods of pulse and blood pressure research, spirometry, spirometry, methods of research of sensory systems, metabolism, higher nervous activity hematological studies); Methods of practical work.	Apply physiological terms in professional activity; Evaluate the physiological states of various cellular, tissue and organ structures; Evaluate the functional systems of the human body and their self-regulation under the influence of internal and external environmental factors; Evaluate the results of laboratory and functional diagnostic methods; Perform practical work under the guidance of a teacher; Evaluate the results of practical work, draw conclusions corresponding to the set goal and the results of experiments.	Skills of independent use of physiological components of the conceptual apparatus.

## Appendix 3

### 8.1. Key literature references:

No.	Name according to bibliographic requirements	Number of copies	
		At the department	In the library
1.	Costanzo, Linda S. Physiology / L.S. Costanzo; Costanzo, Linda S. - 6th ed. - Philadelphia : Elsevier, 2018. - 516 p	1	180
2.	Hall, John E. Textbook of medical physiology / J.E. Hall, A.C. Guyton; Hall, John E. ; Guyton, Arthur C. - 13th ed. - Philadelphia : Elsevier, 2016. - 1145 p.	2	100

### 8.2. Further reading:

No.	Name according to bibliographic requirements	Number of copies	
		At the department	In the library
1	Богданов, А. В. Физиология центральной нервной системы и основы адаптивных форм поведения : Учебник для вузов / А. В. Богданов ; А. В. Богданов. - 2-е изд. ; испр. и доп. - Москва : Юрайт, 2022. - 351 с. - (Высшее образование). - ISBN 978-5-534-11381-5. - Текст : электронный. - URL: <a href="https://urait.ru/bcode/495760">https://urait.ru/bcode/495760</a>		
2	Дегтярев, В. П. Нормальная физиология : учебник / В. П. Дегтярев, Н. Д. Сорокина ; Дегтярев В. П. ; Сорокина Н. Д. - Москва : ГЭОТАР-Медиа, 2019. - 480 с. - ISBN 978-5-9704-5130-4. - Текст : электронный. - URL: <a href="https://www.studentlibrary.ru/book/ISBN9785970451304.html">https://www.studentlibrary.ru/book/ISBN9785970451304.html</a>		
3	Мухина, И.В. Физиология дыхания: учебное пособие / И. В. Мухина, <a href="#">О. А. Горева</a> , <a href="#">В. А. Плеханов</a> , <a href="#">Нижегородская государственная медицинская академия</a> . – 5-е изд., доп. и перераб. – Н.Новгород: Изд-во НижГМА, 2014. – 60 с. : ил.	60	5
4	Ноздрачев, А. Д. Нормальная физиология : учебник / А. Д. Ноздрачев, П. М. Маслюков - Москва : ГЭОТАР-Медиа, 2021. - 1088 с. - ISBN 978-5-9704-5974-4. - Текст : электронный. - URL: <a href="http://www.studmedlib.ru/book/ISBN9785970459744.html">http://www.studmedlib.ru/book/ISBN9785970459744.html</a>		
5	Физиология человека: Атлас динамических схем : учебное наглядное пособие / К. В. Судаков, В. В. Андрианов, Ю. Е. Вагин, И. И. Киселев ; Судаков К. В. ; Андрианов В. В. ; Вагин Ю. Е. ; Киселев И. И. - Москва : ГЭОТАР-Медиа, 2020. - 416 с. - ISBN 978-5-9704-5880-8. - Текст: электронный.-URL: <a href="https://www.studentlibrary.ru/book/ISBN9785970458808.html">https://www.studentlibrary.ru/book/ISBN9785970458808.html</a>		
6	Холл, Д. Э. Медицинская физиология по Гайтону и Холлу / Д. Э. Холл ; Д. Э. Холл. - 2-е, испр. и доп. - М. : Логосфера, 2018. - 1328 с. - ISBN 9785986570600. - Текст : электронный - URL: <a href="https://www.books-up.ru/ru/read/medicinskaya-fiziologiya-">https://www.books-up.ru/ru/read/medicinskaya-fiziologiya-</a>		



	<a href="http://po-gajtonu-i-hollu-4911587/">po-gajtonu-i-hollu-4911587/</a>		
7	Marieb, Elaine N. Essentials of human anatomy and Physiology +1 electronic disk / E.N. Marieb; Marieb, Elaine N. - 9th ed. - San Francisco : Pearson Benjamin Cummings, 2009. - 632 p.	-	3
8	Shier, D. Hole`s essentials of human anatomy & physiology / D. Shier, J. Butler, R. Lewis; Shier, D. ; Butler, J. ; Lewis, Ricki. - 12th ed. - New York : McGraw-Hill Education, 2015. - 632 p. : il.	-	1
9	Sembulingam, K. Essentials of medical physiology / K. Sembulingam, P. Sembulingam; Sembulingam, K. ; Sembulingam, Prema. - 5th ed. - St. Louis : Jaypee Brothers Medical Publishers (P) LTD., 2010. - 1025 p.	-	1
10	Waugh, Anne. Ross and Wilson anatomy and physiology in health and Illness / A. Waugh, A. Grant; Waugh, Anne ; Grant, A. - 12th ed.- Edinburgh : Churchill Livingstone, 2014. - 509 p.	-	1
11	Physiology / R.M. Berne, B.M. Koeppen, M.N. Levy, B.A. Stanton. - 5th ed. - : Mosby, 2004. - 1014p.	3	50
12	Silbernagl, S. Color atlas of physiology / S. Silbernagl, A. Despopoulos. - 6th ed. - Stuttgart : Thieme, 2009. - 441 c	-	11

### 9.3. A set of licensed and freely distributed software, including domestic production

Item no.	Software	number of licenses	Type of software	Manufacturer	Number in the unified register of Russian software	Contract No. and date
1	Wtware	100	Thin Client Operating System	Kovalev Andrey Alexandrovich	1960	2471/05-18 from 28.05.2018
2	MyOffice is Standard. A corporate user license for educational organizations, with no expiration date, with the right to receive updates for 1 year.	220	Office Application	LLC "NEW CLOUD TECHNOLOGIES"	283	without limitation, with the right to receive updates for 1 year.

3	LibreOffice		Office Application	The Document Foundation	Freely distributed software	
4	Windows 10 Education	700	Operating systems	Microsoft	Azure Dev Tools for Teaching Subscription	
5	Yandex. Browser		Browser	«Yandex»	3722	
6	Subscription to MS Office Pro for 170 PCs for FGBOU VO "PIMU" of the Ministry of Health of Russia	170	Office Application	Microsoft		23618/HN10030 LLC "Softline Trade" from 04.12.2020