Federal State Autonomous Educational Institution of Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA
NAMED AFTER PATRICE LUMUMBA
RUDN University
Institute of Medicine

educational division (faculty/institute/academy) as higher education programme developer

COURSE SYLLABUS

NORMAL PHYSIOLOGY

(course title)

Recommended by the Didactic Council for the Education Field of:

05.31.01 GENERAL MEDICINE

(field of studies / speciality code and title)

The course instruction is implemented within the professional education programme of higher education:

GENERAL MEDICINE

higher education programme profile/specialisation title

2026

1. COURSE GOAL(s)

The course "Normal Physiology" is included in the specialist program "General Medicine" under the specialty code 31.05.01 "General Medicine" and is studied in semesters 3 and 4 of the second year. The discipline is delivered by the Department of Normal Physiology. The discipline consists of 13 sections and 38 topics and is aimed at studying fundamental information on the mechanisms and patterns of physiological processes in the human body.

The goal of mastering the course is for the student to acquire knowledge about the development of structures and functions of various body systems based on modern achievements in physiological science, which is necessary for the formation of a natural scientific worldview and for practical medical activity.

2. REQUIREMENTS FOR LEARNING OUTCOMES

Mastering the course "Normal Physiology" is aimed at developing the following competencies (or parts thereof) in students:

Table 2.1. List of competences that students acquire during the course

Competence code	**Competence descriptor**	**Competence formation indicators** (within this course)
GPC-5	Able to assess morphofunctional, physiological states and pathological processes in the human body to solve professional tasks	GPC-5.1 Masters the algorithm of clinical-laboratory and functional diagnostics in solving professional tasks; GPC-5.2 Able to evaluate the results of clinical-laboratory and functional diagnostics in solving professional tasks, including with the use of artificial intelligence technologies; GPC-5.3 Able to determine morphofunctional, physiological states and pathological processes in the human body based on knowledge of the structure of the human body, functioning of organs and systems in health and disease;
GPC-7	Able to prescribe treatment and monitor its effectiveness and safety	GPC-7.1 Masters methods of general clinical examination, interpretation of results of laboratory and instrumental diagnostic methods;

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The course refers to the core/variable/elective* component of (B1) block of the highere ducational programme curriculum.

* - Underline whatever applicable.

Within the higher education programme students also master other (modules) and / or internships that contribute to the achievement of the expected learning outcomes as results of the course study.

Table 3.1. The list of the higher education programme components/disciplines that contribute to the achievement of the expected learning outcomes as the course study results

Competence code	**Competence descriptor**	**Previous courses/modules, internships***	**Subsequent courses/modules, internships***
GPC-5	Able to assess morphofunctional, physiological states and pathological processes in the human body to solve professional tasks	Biology; Chemistry; Bioorganic Chemistry; Anatomy; Histology, Embryology, Cytology;	General Surgery; Obstetrics and Gynecology; Microbiology, Virology; Oncology, Radiation Therapy; Pathophysiology, Clinical Pathophysiology; Molecular Genetic Methods;

Code	Name of competency	Preceding disciplines/modules, practices*	Subsequent disciplines/modules, practices*
			Methods of Microbiological Diagnostics; Propaedeutics of Internal Diseases; Immunology; Pathological Anatomy, Clinical Pathological Anatomy; Radiology; Medical Elementology; Phthisiology; Anesthesiology, Resuscitation, Intensive Care; Ophthalmology; Methods of Cell Biology and Histology; Pharmacology; Topographic Anatomy and Operative Surgery; Forensic Medicine; Maxillofacial Surgery; Medical Criminalistics; Otorhinolaryngology; Pediatrics; Autopsy Course;
GPC-7	Able to prescribe treatment and monitor its effectiveness and safety	Histology, Embryology, Cytology;	General Surgery; Otorhinolaryngology; Outpatient Therapy; Ophthalmology; Clinical Pharmacology; Cardiology in Quests; Propaedeutics of Internal Diseases; Pediatrics; Maxillofacial Surgery; Pharmacology; General Practitioner Internship: assistant to a physician in an outpatient clinic;

* - to be completed in accordance with the competency matrix and the HEP Curriculum and Work Plan
** - elective disciplines/practices

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total workload of the "Normal physiology" course is 8 credits (180 academic hours).

*Table 4.1. Types of academic activities during the periods of higher education programme mastering (**full-time training**)**

Type of educational work	**TOTAL,** academic hours	**Semesters / module**	
		3	**4**
Contact work, academic hours	*210*	*102*	*108*
Lectures **(LC)**	70	34	36
Laboratory work **(LW)**	0	0	0

Practical/seminar classes **(S)**	140		68	72
Independent work of students, academic hours	*33*		*15*	*18*
Assessment (exam/credited test with grade), academic hours	*45*		*27*	*18*
Total labor intensity of the discipline	**academic hours**	***288***	*144*	*144*
	credit units	***8***	*4*	*4*

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5. COURSE CONTENTS

Table 5.1. Content of the discipline (module) by types of academic work

Course module title	Course module contents (topics)	Academic activities types
Section 1 Introduction to Physiology.	1.1 Introduction to Physiology. History of development, main stages. Methods of physiological science. Physiology as a science. History of physiology: ancient period, establishment of experimental physiology, modern stage. Development of physiology in Russia. Methods of physiological research: observation, acute and chronic experiment, extirpation, denervation, transplantation, fistula method, electrophysiological, imaging, biochemical and molecular methods, radioisotope tracer method, mathematical modeling. Familiarization with safety regulations and rules of conduct in the educational laboratory.	LC, S
Section 2 Physiology of Excitable Tissues	2.1 Biophysics of membranes. Excitability and its assessment. Membrane potential, resting potential, mechanism of occurrence and its measurement. Excitability and its assessment, phase changes in excitability during action potential. Criteria of excitability. Ionic mechanisms of action potential, graph, characteristics of ion channels ensuring excitation. Laws of irritation of excitable tissues. Preparation of neuromuscular preparation and isolated gastrocnemius muscle preparation of a frog. Reproduction of Galvani's first experiment (with metal). Determination of nerve and muscle irritation thresholds.	LC, S
	2.2 Physiology of the synapse. Physiology of the nerve fiber, nerve. Structure and properties of electrical and chemical synapses. Excitatory and inhibitory synapses. Mediators of the central and peripheral nervous systems, their interaction with metabotropic and ionotropic receptors. Properties of the nerve fiber and nerve. Propagation of excitation along the nerve fiber. Classification of nerve fibers by conduction velocity. Parabiosis. Effect of myorelaxin (curare) on the neuromuscular synapse.	LC, S
	2.3 Physiology of muscles. Types of muscles, their physiological properties. Mechanisms of contraction of skeletal, smooth and cardiac muscles. Sliding filament theory. Types of skeletal muscle fibers. Mechanics of muscle contraction. Types and varieties of muscle contractions. Work and fatigue. Muscle strength. Recording of single muscle contractions, serrated and smooth tetanus. Dynamometry. Study of maximum voluntary strength and strength endurance.	LC, S
Section 3 Physiology of the Central Nervous System	3.1 Physiology of the central nervous system. Nervous regulation of physiological functions. Reflex. Physiology of the central nervous system. Nervous regulation of physiological functions. Reflex and its characteristics. Types of reflexes. Excitation and inhibition in the central nervous system. Main properties of nerve centers. Reflex regulation of visceral and somatic functions. Coordination and integration of intracentral processes. Analysis of the reflex arc. Receptive field of the spinal reflex. Determination of reflex time by Turk. Study of unconditional reflexes in humans.	LC, S

	3.2 Special physiology of the central nervous system. Methods for studying functions of the central nervous system. Functions of different parts of the central nervous system (spinal cord, brainstem, diencephalon, cerebral hemispheres, cerebellum). Limbic system. Electrical activity of the cerebral cortex. Methods for studying the CNS in clinical practice and experiment. Blood-brain barrier, its structure and functions. Composition and purpose of cerebrospinal fluid. Central inhibition of spinal reflexes (Sechenov inhibition). Study of cerebellar control of motor activity of skeletal muscles.	LC, S
	3.3 Physiology of the autonomic nervous system. Sympathetic, parasympathetic, metasympathetic nervous system. Synaptic transmission of the autonomic nervous system. Mediators and receptors of the ANS. Role of the autonomic nervous system in the development of adaptive reactions. Approximate assessment of human autonomic tone by questionnaire method. Assessment of autonomic tone by Kerdo index. Determination of reactivity of the sympathetic division of the autonomic nervous system (orthostatic test). Determination of reactivity of the parasympathetic division of the autonomic nervous system (clinostatic test).	LC, S
Section 4 Physiology of Endocrine Glands	4.1 Humoral regulation of physiological functions. Endocrine system. Concept of humoral regulation. Levels of structural organization of the endocrine system. Classification of hormones. General properties of hormones, hierarchy in the activity of endocrine glands. Types of physiological action and mechanisms of hormone action. Interaction of hormones.	LC, S
	4.2 Physiology of endocrine glands. Hypothalamic-pituitary system. Endocrine regulation of blood glucose level. Pituitary gland and its connections with the hypothalamus. Physiological functions of pituitary hormones. Insulin, glucagon and their metabolic effects. Mechanisms ensuring maintenance of blood glucose level. Determination of blood glucose concentration in humans. Assessment of glycemic curve when consuming products with different glycemic indices.	LC, S
	4.3 Special physiology of endocrine glands: thyroid and parathyroid glands, adrenal glands, gonads. Thyroid hormones and their metabolic functions. Synthesis and secretion of iodine-containing thyroid hormones. Regulation of thyroid hormone secretion. Mechanism of action of thyroid hormones on target cells. Role of calcitonin and parathyroid hormone in regulation of calcium and phosphorus metabolism. Corticosteroids. Physiological effects and mechanisms of action of glucocorticoids and mineralocorticoids. Hormones of the adrenal medulla, functions and mechanisms of their action. Male sex hormones, functions and mechanisms of action, regulation of secretion. Female sex hormones, functions and mechanisms of action, regulation of secretion. Role of various hormones and mechanism of their action in regulation of menstrual cycle phases. Hormonal support of various periods of pregnancy.	LC, S
Section 5 Physiology of Sensory Systems	5.1 General physiology of analyzers. General concept of analyzers (sensory systems). I.P. Pavlov's theory of analyzers. Schemes of organization of sensory systems and characteristics of their functions. Significance of sense organs for sensory systems. Role of receptors and higher CNS divisions in perception of the external world. Sensory receptors: concept, function, classification, properties and features. Concept of receptor and generator potentials. Adaptation of sensory systems, its peripheral and central mechanisms.	LC, S
	5.2 Somatosensory system. Classification of somatic sensations. Cutaneous analyzer: tactile and temperature sensitivity (receptors, conducting pathways, central division). Proprioception, characteristics of receptors, conducting pathways and central divisions. Role in perception and assessment of body position in space, in formation of muscle tone, posture and movements. Determination of spatial	LC, S

	threshold of tactile sensitivity (esthesiometry). Study of temperature sensitivity (thermoesthesiometry).	
	5.3 Physiology of vision. Physiology of the retina. Scheme of retinal structure considering direction of light. Functional significance of retinal elements. Photochemical processes in the retina under light exposure and formation of receptor potential. Color vision. Conducting pathways and cortical division of the visual analyzer. Regulation of eye movements, accommodation and pupil diameter. Determination of visual acuity. Determination of visual field (perimetry).	LC, S
	5.4 Physiology of hearing and vestibular apparatus. Auditory sensory system. Structure and functions of the organ of hearing. Mechanisms of sound wave conduction and sensory transduction in receptor cells. Conducting pathways and central division of the auditory analyzer, effector control of outer hair cells. Mechanisms of perception and analysis of sounds of different intensity and frequency, direction of sound source. Theories of sound coding. Methods for studying the auditory analyzer. Comparison of air and bone conduction (Rinne test). Structure and functions of the vestibular analyzer (receptor division, conducting pathways, central division). Connection of vestibular sensitivity with muscle tone and eye movements. Methods for studying the vestibular analyzer.	LC, S
	5.5 Physiology of taste and smell. Physiological characteristics of gustatory and olfactory sensory systems (receptors, conducting pathways, central division). Significance of taste reception. Mechanisms of formation of receptor potential of different types of taste receptors. Determination of thresholds of taste sensitivity. "Determination of the role of olfaction in the emergence of taste sensations".	LC, S
	5.6 Pain. The problem of pain in medicine. Pain sensitivity. Characteristics of receptors. Mechanisms of perception of painful stimuli. Features of structure and properties of conducting pathways and central divisions. Central mechanisms of pain. Types of pain. Antinociceptive systems, their various levels. Neurochemical mechanisms of antinociception. Physiological mechanisms of analgesia.	LC, S
Section 6 Physiology of Higher Nervous Activity	6.1 HNA. Conditioned reflex. Excitation and inhibition in the cerebral cortex. Types of HNA and temperament. Sleep. Theory of higher nervous activity. Innate forms of behavior (unconditioned reflexes and instincts: classification, conditions of manifestation, biological role). Differences between conditioned and unconditioned reflexes. Role of I.P. Pavlov in creating physiological foundations of mental activity. Excitation and inhibition in the cerebral cortex. Conditioned reflex, types, mechanisms of formation. Types of inhibition of conditioned reflexes, conditions of their occurrence, mechanisms, biological significance. Types of HNA according to I.P. Pavlov. I and II signaling systems. Correlation between type of HNA and temperament. Dynamic stereotype. Functional disorders of higher nervous activity. Experimental neuroses. Sleep-wake cycle and its regulation. Sleep, its neurophysiological mechanisms and functional significance. Sleep phases, their EEG criteria. Vegetative and somatic manifestations of different sleep phases. Determination of typological features of HNA in humans according to I.P. Pavlov. Determination of psychological characteristics of personality using the EPI personality questionnaire (H. Eysenck method).	LC, S
	6.2 Memory. Mechanisms of memory. Theory of the functional system of behavior (P.K. Anokhin). Memory, its types. Concepts of neurophysiological mechanisms of short-term and long-term memory. Architecture of an integral behavioral act from the perspective of P.K. Anokhin's theory of functional systems. Study of attention switching. Dependence of memory volume on degree of meaningfulness of	LC, S

	material.	
	6.3 Motivations and emotions. Social role of motivations and emotions. Motivation as the basis of personality. Sphere of consciousness, subconsciousness, superconsciousness. Emotions: definition, types. Theories of emotions. Concept of neurophysiological mechanisms of emotion formation. Role of the cerebral cortex, limbic system. State of CNS functions, somatic, autonomic, endocrine functions of the body under various emotions.	LC, S
Section 7 Physiology of Blood	7.1 Constancy of the internal environment (homeostasis). Function and composition of blood. Blood constants. Blood plasma. Formed elements of blood. Physiological concepts of homeostasis as constancy of the internal environment of the body, functions and mechanisms regulating it. Main indicators of blood homeostasis. Concept of the blood system (G.F. Lang). Significance and main functions of blood. Composition and quantity of blood (quantity of formed elements, plasma composition). Plasma and serum. Blood plasma proteins, their characteristics and functional significance. Hematocrit indicator. Concept of age norms of main indicators of complete blood count: hemoglobin content, number of erythrocytes, leukocytes, color index, ESR, their diagnostic significance. Leukocytes, their characteristics (varieties, functions of individual types, quantity in blood). Leukocyte formula, age-related features. Leukocyte count. Erythrocytes and hemoglobin. Features of structure and properties of erythrocytes and hemoglobin ensuring performance of their functions. Types of hemoglobin and its compounds. Erythrocyte count. Determination of hemoglobin content by Sali method. Calculation of blood color index. Study of osmotic resistance of erythrocytes. Study of different types of hemolysis. General characteristics of erythrocyte blood group systems in humans. Characteristics and features of the ABO system. Significance of determining Rh factor. Problem of Rh conflict between mother and fetus. Determination of blood group according to ABO system and Rh factor. Lymph: composition, mechanisms of formation. Role of lymph in the body.	LC, S
	7.2 System of regulation of the aggregate state of blood. Buffer systems of blood. General concept of the system regulating the aggregate state of blood: coagulation, anticoagulation and fibrinolytic systems. Vascular-platelet hemostasis. Role of vascular wall and platelets, stages of platelet thrombus formation. Platelets: formation, structural features, quantity, functions. Coagulation hemostasis: phases of coagulation. Role of individual coagulation factors. Characteristics of the fibrinolytic system and its factors. Significance and mechanisms of fibrinolysis. Characteristics of the anticoagulation system and its factors. Concept of anticoagulants. Main methods of clinical diagnostics of vascular-platelet and coagulation hemostasis. Determination of bleeding time. Determination of clotting time. Fibrinolysis. Acid-base state of blood, main constants characterizing it. Functional system maintaining blood pH in the body. Buffer systems of blood. Acidosis and alkalosis (types, physiological compensation mechanisms).	LC, S
Section 8 Physiology of Respiration	8.1 Role of the respiratory system in the body. External respiration. Five stages of the respiratory process, their brief characteristics. External and internal respiration. Physiological role of respiratory tract and lungs. Non-respiratory functions of lungs. Biomechanics of inhalation and exhalation. Graphs of changes in intra-alveolar and intrapleural pressure in different phases of the respiratory cycle. Characteristics of main and accessory respiratory musculature during quiet and forced breathing. Lung ventilation. Static indicators of lung ventilation: lung volumes and capacities, their age-related dynamics. VC, calculation formula. Elastic recoil of lungs and chest wall. Lung compliance and its changes with age. Composition and role of surfactant. Pressure in the pleural cavity, its origin and role in the mechanism of lung ventilation. Concept of pneumothorax. Dead space and its types.	LC, S

	Normal values of dead space and measurement technique. Methods for studying pulmonary ventilation. Spirometry.	
	8.2 Gas exchange. Transport of respiratory gases. Composition of atmospheric, alveolar and expiratory air. Gas exchange between alveoli and blood. Significance of partial pressures of O_2 and CO_2 in alveolar air and gas tension in arterial, venous blood and tissues. Conditions and directions of gas diffusion through the alveolocapillary membrane. Gas cascade: scheme of oxygen and carbon dioxide diffusion in lungs and tissues. Transport and forms of oxygen carriage by blood. Oxygen capacity of blood. Oxyhemoglobin dissociation curve. Influence of various conditions on the dissociation process. Gas exchange between blood and tissues. Transport of carbon dioxide by blood. Factors influencing hemoglobin affinity for CO_2. Blood deoxygenation and conditions determining it. Coefficient of O_2 utilization by tissues at rest and during physical activity. Pulse oximetry.	LC, S
	8.3 Regulation of respiration. Respiration under altered conditions of gaseous environment. Respiratory center: concept of its structure and localization. Automaticity of the respiratory center. Mechanism of alternation of respiratory phases, afferent and efferent connections. Regulatory influence on the respiratory center from higher brain divisions. Reflex regulation of respiration. Protective adaptations in the respiratory process. Humoral regulation of respiration. Role of O_2, CO_2 and H^+. Illustration of the role of humoral factors in regulation of respiration in experiment. Central and peripheral chemoreceptors. Hypoxic and hypercapnic stimuli in regulation of respiration. Mechanism of the newborn's first breath. Features of respiration during physical activity, increased and decreased atmospheric pressure. Hyperbaric therapy. Toxic effects of oxygen. Decompression sickness. Mountain sickness. Conducting hypoxemic tests of Stange and Genchi.	LC, S
Section 9 Physiology of the Cardiovascular System	9.1 Physiology of the cardiovascular system. Cardiac cycle. Propagation of excitation through the myocardium. Conducting system of the heart. Phases of the cardiac cycle and their duration, state of valves in each phase, pressure in heart cavities, direction of blood flow. Characteristics of cardiac activity: stroke volume, end-diastolic volume, end-systolic volume, ejection fraction. Cardiac output. Cardiac index. Cardiac work. Sound manifestations of cardiac activity: heart sounds, their origin. Auscultation and phonocardiography (PCG). Cardiac cycle in a frog. Analysis of the conducting system of the heart by ligature method (Stannius ligatures). Conducting system of the heart, its role, physiological properties and functions of various cells. Cardiac automaticity, its causes, gradient of automaticity. Graph of action potential of conducting system cells, its phases and ionic mechanisms. Concept of artificial cardiac pacemakers.	LC, S
	9.2 Properties of cardiac muscle. Extrasystole. Mechanisms of contractile activity of the myocardium. Physiological properties and features of working myocardium. Graph of action potential of working cardiomyocytes, comparison with mechanical activity, characteristics of phases and ionic mechanisms. Graph of changes in excitability of working myocardium during action potential. Extrasystoles: concept, types, causes of their occurrence. Reproduction of extrasystole.	LC, S
	9.3 Nervous and humoral regulation of cardiac work. Methods for studying the heart. Electrical phenomena in the heart. Reflex regulation of cardiac activity. Main reflexogenic zones and their significance. Intracardiac mechanisms of regulation of cardiac activity. Intracardiac nervous system and its role in regulation of cardiac activity. Influence of venous return and vascular resistance on cardiac activity. Frank-Starling law of the heart, Anrep phenomenon – mechanisms, significance. Regulation of cardiac activity by autonomic nerves: types of influences, mechanisms, mediators, receptors. Humoral mechanisms of cardiac regulation. Influence of electrolytes, metabolites, hormones on cardiac function. Electrophysiological foundations of electrocardiography. Dipole theory of ECG genesis, types of ECG leads. Elements of ECG and their characteristics:	LC, S

	causes of occurrence, duration, amplitude. Determination of the source of cardiac rhythm. Electrical axis of the heart and method of its determination. Calculation of heart rate. Recording of electrocardiogram. Interpretation of normal electrocardiogram. Intervalogram. Polycardiography.	
	9.4 Physiology of blood vessels. Main laws of hemodynamics. Microcirculation and lymph flow. Methods for studying circulation. Main laws of hemodynamics, formulas describing them. Application of hemodynamic laws to explain physiological patterns of blood movement. Functional classification of vessels. Changes in cross-sectional area, resistance, linear and volumetric blood flow velocity, pressure in vessels of the systemic circulation. Features of blood movement through arteries. Indicators of arterial blood pressure, calculation formulas. Arterial blood pressure under various functional states of the body. Techniques for measuring arterial blood pressure. Invasive and non-invasive methods of determining arterial blood pressure. Blood pressure measurement. Pulse wave, its origin and clinical-physiological characteristics. Arterial sphygmogram. Capillary blood flow and its features. Microcirculation and its role. Mechanisms of transcapillary exchange between blood and tissues. Methods for studying microcirculation. Blood movement through veins. Factors influencing magnitude of venous return and venous pressure. Venous pulse curve. Structure and functions of the lymphatic system. Mechanisms of lymph formation and outflow.	LC, S
	9.5 Regulation of circulation. Vasomotor nerves. Hierarchy of vasomotor centers. Redistribution of blood. Vascular tone, its types, proof of presence and regulation. Role of endothelium in maintaining vascular tone. Mechanisms of vasoconstriction and vasodilation. Localization and functional divisions of the vasomotor center, its afferent and efferent connections. Main reflexogenic zones ensuring vascular tone. Significance of peripheral chemoreceptors. Features of circulation and blood flow regulation in coronary, cerebral, pulmonary and renal vessels, features of fetal circulation. Fast, medium-term and long-term mechanisms of blood pressure regulation, their characteristics and significance. Physiological significance of redistribution of blood mass. Assessment of cardiovascular system parameters at rest and during physical activity.	LC, S
bSection 10 Excretion, Physiology of the Kidneys	10.1 System of excretory organs. Urine formation in the kidneys. Kidneys as an organ of homeostasis. General characteristics of the excretory system: organs and systems of excretion in the body. Structure of the urinary system. General concept of kidney functions. Nephron as the morphofunctional unit of the kidney, types of nephrons, features of blood supply, functions. Main processes of urine formation. Concepts of glomerular diuresis. Scheme of the structure of the renal filter. Concept of threshold and non-threshold substances. Mechanisms of filtration. Effective filtration pressure. Glomerular filtration rate and methods of its determination. Mechanisms of regulation of glomerular filtration. Concepts of tubular diuresis. Osmotic dilution and concentration of urine in the nephron. Work of the countercurrent multiplier system and its significance. Features and mechanisms of tubular reabsorption and secretion in different parts of the nephron. Regulation of these processes. Role of aquaporins. Ammoniagenesis. Comparative characteristics of blood plasma, primary and final urine. Study of certain urine components using diagnostic strips. Norms of general urine analysis. Diagnostic significance of general urine analysis.	LC, S

		10.2 Non-urine-forming functions of the kidneys. Role of kidneys in development of adaptive reactions of the body. Urinary bladder and urination. Methods for studying kidney function. Role of kidneys in regulation of systemic arterial pressure and circulating blood volume. Mechanisms of regulation. Significance of RAAS. Role of kidneys in maintaining acid-base balance. Functional system maintaining water-electrolyte balance and osmotic pressure of body fluids. Role of atrial natriuretic peptides, aldosterone and ADH. Role of kidneys in maintaining phosphorus-calcium metabolism. Main indicators of kidney function. Methods for studying kidney function. Assessment of filtration, secretion, reabsorption values. Clearance of inulin, creatinine, PAH and cystatin C. Function of the urinary bladder. Urine formation and urination, their regulation.	LC, S
Section 11	Physiology of Digestion	11.1 Structure and functions of the digestive tract. Methods for studying digestive functions. Physiological foundations of hunger and satiety. General principles of regulation of digestive processes. Digestion, its significance for vital activity and maintenance of homeostasis. Digestive and non-digestive functions of the digestive system. Role of I.P. Pavlov in creating the modern theory of digestive physiology. Types of digestion depending on localization and origin of hydrolytic enzymes. Methods for studying secretory and motor functions of the gastrointestinal tract in experiment. Advantages of chronic experiment in studying functions of the digestive tract. Modern methods for studying the digestive system in clinical practice. General principles of regulation of digestive system activity. Role of reflex, humoral and local regulatory mechanisms and their correlation. Gastrointestinal hormones, their effects. Modern concepts of formation of food motivation. Appetite. Food center. Physiological mechanisms of hunger and satiety. Functional system ensuring constancy of nutrients in blood (P.K. Anokhin).	LC, S
		11.2 Motility of the digestive tract. Digestion in the oral cavity and stomach. Secretory and motor functions. Digestion in the oral cavity. Mechanical and chemical processing of food. Composition, quantity and properties of saliva. Saliva formation, salivation, regulatory mechanisms. Adaptive variability of salivation, its regulation. Determination of active reaction of saliva (pH) using universal indicator paper. Swallowing, its phases. Reflex regulation of swallowing. Functional connection of respiration, mastication and swallowing processes. Esophagus. Motor function of the esophagus. Motor and evacuator functions of the stomach when fasting and after food intake. Mechanisms of food passage from stomach to duodenum. Digestion in the stomach. Composition, quantity and properties of gastric juice. Physiological role of enzymes, HCl and gastric mucus. Study of enzymatic properties of gastric juice. Phases and mechanisms of regulation of gastric secretion. Adaptive character of gastric secretion to types of food and dietary rations. Role of gastrointestinal peptides. Curves of gastric secretion.	LC, S
		11.3 Secretion in the GIT. Digestion in the small and large intestine. Role of the liver in digestion. Absorption of nutrients in the gastrointestinal tract. Digestion in the duodenum. Exocrine activity of the pancreas. Composition, quantity and properties of pancreatic juice. Mechanisms and regulation of pancreatic juice secretion, its adaptive character. Digestion in the jejunum and ileum. Composition, quantity and properties of intestinal juice. Mechanisms of regulation of intestinal secretion. Motor function of the small intestine and its regulation. Digestive function of the liver. Composition, quantity and properties of bile, its role in the digestive process. Effect of bile on fats. Bile formation and bile excretion. Regulation of bile formation and its release into the duodenum. Features of digestion in the large intestine. Role of bulk substances. Physiological foundations of enterosorption. Significance of normal microflora of the large intestine for the body. Motor activity of the large intestine and its regulation. Mechanisms of defecation. Features of hydrolysis of proteins, fats and carbohydrates in different parts of the gastrointestinal tract. Absorption of substances in different parts of the digestive tract. Types and mechanisms of substance absorption through biological membranes. Coupling of hydrolysis and absorption.	LC, S

Section 12 Metabolism and Energy. Thermoregulation.	12.1 Human metabolism. Energy metabolism. Determination of metabolic rate. Basal metabolism, daily energy expenditure. Intake and expenditure of substances in the body. Metabolism of proteins, fats, carbohydrates and trace elements. Laws of thermodynamics and their application in physiology. Organism as a thermodynamic system. Types of calorimetry. Calorimetric coefficient of a substance, respiratory quotient and calorimetric equivalent of oxygen. Caloric value of food products. Concept of metabolism and energy. Characteristics of anabolism and catabolism processes. Basal metabolism, magnitude and factors determining it. Standard conditions. Determination of expected basal metabolism by various methods. Determination of percentage deviation of basal metabolism from normal by Reed method. Methods for determining energy expenditure of the body. Energy balance of the body. Working metabolism. Specific dynamic action of food. Energy expenditure of the body under different types of labor activity. Determination of daily energy expenditure of the body. Plastic and energy role of proteins, fats and carbohydrates. Physiological significance of water and mineral substances in the body. General biological characteristics of main groups of vitamins.	LC, S
	12.2 Neurohumoral regulation of metabolism in the body. Physiological foundations of nutrition. Metabolism of proteins, fats, carbohydrates and its regulation. Role of the liver in metabolism of carbohydrates, fats and proteins. Body weight as an objective indicator of balance between intake and expenditure of energy. Concept of normal body weight and its regulation. Physiological foundations of nutrition. Concept of normal requirement for nutrients. Nutrition norms depending on age, type of work and state of the body. Daily requirement for proteins, fats, carbohydrates. Nitrogen balance. Physiological principles of composing food rations. Concept of rational balanced nutrition. Assessment of human metabolic state by body weight analysis (calculations of body mass index and ideal body weight). Assessment of distribution of fat deposits in humans by waist/hip ratio. Assessment of body fat mass in humans by caliperometry. Composition and assessment of food rations.	LC, S
	12.3 Thermoregulation. Body temperature. Features of the thermoregulation system. Significance of constancy of internal environment temperature for normal course of vital processes. Concept of temperature core and shell. Human body temperature and its daily fluctuations. Study of body temperature. Concept of hypothermias and hyperthermias. Heat production. Sources and mechanisms of heat formation in the body. Contractile and non-contractile thermogenesis. Nervous and humoral mechanisms of regulation of heat production. Heat loss. Physical and physiological mechanisms of heat loss, ways of heat dissipation from the body surface. Nervous and humoral mechanisms of regulation of heat loss. Thermoregulation centers. Mechanisms of thermoregulation under exposure to low and high ambient temperature. Functional system ensuring maintenance of constancy of internal environment temperature.	LC, S
Section 13 Integration of Physiological Functions. Adaptation of the Organism. Modern Directions of Research in Physiology.	13.1 Systemic mechanisms of integration of physiological functions. Adaptation of the organism to changing conditions of the external environment. Modern directions of research in physiology. Concept and significance of integration of physiological functions. Main principles of systemic integration. Theory of functional systems (P.K. Anokhin). Practical application of knowledge about integration. Levels, types and mechanisms of adaptation of the organism to changing conditions of the external environment. Adaptive reserves and limits of adaptation. Practical significance of knowledge about adaptation. Promising directions of research in physiology and their clinical significance.	LC, S

* – to be completed only for **FULL-TIME** study: LC – lectures; LW – laboratory work; S – practical/seminar classes.

6. COURSE EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Classroom equipment and technology support requirements

Type of auditorium	Equipment of the auditorium	Specialized educational/laboratory equipment, software and materials for mastering the discipline (if necessary)
Lecture	Auditorium for conducting lecture-type classes, equipped with a set of specialized furniture; board (screen) and technical means for multimedia presentations.	Set of specialized furniture; technical means: multimedia projector "Optoma", speakers "Genius", nettop Lenovo, wall-mounted screen with electric drive.
Seminar	Auditorium for conducting seminar-type classes, group and individual consultations, current monitoring and interim assessment, equipped with a set of specialized furniture and technical means for multimedia presentations.	Set of specialized furniture; technical means: multimedia projectors "Optoma", "View Sonic", speakers "Genius", "Dialog", nettops Lenovo, personal computers "CM", wall-mounted screens with electric drive Digis. Educational computer programs used in practical classes: testing program "Mytest". Technical means: complex for laboratory work (BIOZHEZL), educational films, universal stand, set of tables, universal indicator paper (pH), test strips for determining urine components, neurological hammer, caliper, measuring tape, Weber compass, ruler, set of tuning forks, hand dynamometer, coliclon Anti-A, Anti-B and anti-AB for determining blood groups according to ABO system, coliclon Anti-D for determining Rh factor according to Rh system, microscopes "Mikromed", electrocardiographs EK1T-O7 and Axion, sphygmomanometer, phonendoscope, air spirometer, stopwatch, Förster perimeter, Sivtsev tables, portable glucometer, electroencephalograph, thermoesthesiometer, templates for thermoesthesiometry, sets of laboratory glassware.

Self-studies	Audience for independent work of students (may be used for conducting seminar classes and consultations), equipped with a set of specialized furniture and computers with access to the Electronic Information and Educational Environment (EIEE).	Set of specialized furniture; technical means: multimedia projector "Optoma", speakers "Genius", nettop Lenovo, wall-mounted screen with electric drive.

* – audience for independent work of students must be indicated **MANDATORILY!**

7. RESOURCES RECOMMENDED FOR COURSE STUDY

Core readings:

1. Мельник, В. А. Human physiology = Физиология человека. В 2 частях. Часть 1 : учебное пособие / В.А. Мельник, С.Н. Мельник, Ю.И. Брель ; под ред. В.А. Мельника ; пер. на англ. яз. М.В. Петренко, Ю.И. Брель, С.И. Мельник, В.А. Мельник. — Москва : ИНФРА-М ; Гомель : ГомГМУ, 2026. — 304 с. : ил. - ISBN 978-5-16-021637-9. - Текст : электронный. - URL: https://znanium.ru/catalog/product/2233195 (дата обращения: 28.04.2026). – Режим доступа: по подписке.

Additional readings:

1. Normal physiology = Нормальная физиология : textbook for students indepedent work / Ye.V. Dorokhov, A.V. Karpova, Y.V. Bulgakova [et al.]. - Moscow : GEOTAR-Media, 2021. - : il. - Книга на английском языке.
2. Избранные лекции по нормальной физиологии = Selected Lectures on Normal Physiology : учебное пособие / М.М. Лапкин, Е.А. Трутнева ; Лапкин М.М., Трутнева Е.А. - Москва : ГЭОТАР-Медиа, 2021. - 544 с. URL: https://mega.rudn.ru/MegaPro/UserEntry?Action=Link_FindDoc&id=519199&idb=0

Resources of the information and telecommunication network "Internet":

1. RUDN ELS and third-party ELS to which university students have access based on concluded agreements:
- Electronic Library System of RUDN – ELS RUDN http://lib.rudn.ru/MegaPro/Web
- ELS "University Library Online" http://www.biblioclub.ru
- ELS Yurait http://www.biblio-online.ru/
- ELS "Consultant Student" www.studentlibrary.ru
- ELS "Troitsky Most"

2. Databases and search engines:
- Electronic fund of legal and normative-technical documentation http://docs.cntd.ru/
- Search engine Yandex https://www.yandex.ru/
- Search engine Google https://www.google.ru/
- Abstract database SCOPUS http://www.elsevierscience.ru/products/scopus/

*Educational and methodological materials for independent work of students in mastering the discipline/module:**

1. Course of lectures on the discipline "Normal Physiology".

* – all educational and methodological materials for independent work of students are placed in accordance with the current procedure on the discipline page **in E-SYSTEM!**

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