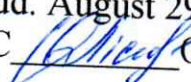




**INTERNATIONAL EUROPEAN UNIVERSITY**  
**EDUCATIONAL AND RESEARCH INSTITUTE**  
**"EUROPEAN MEDICAL SCHOOL"**

**Department of Fundamental, Medical and Preventive  
Disciplines**

**APPROVED** by  
The Scientific and Methodical Council of the  
University, protocol dd. August 29, 2023 No. 7  
Deputy Chair of SMC  O. LISNICHUK

**WORKING PROGRAM OF THE ACADEMIC DISCIPLINE:**  
**PHYSIOLOGY**

to train students of the second (Master's) level  
(full-time mode of study)

**Knowledge area** 22 "Health care"

**Specialty** 222 "Medicine"

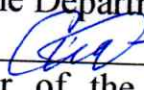
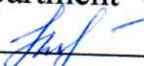
**Educational program:** Medicine

**Discipline status:** Compulsory

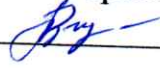
Kyiv – 2023

The working program of the **Physiology** academic disciplines is based on the Medicine educational and professional program for the second (Master) level of the 222 Medicine specialty approved by the University Academic Council on May 30, 2023, protocol №4.

PROGRAM DEVELOPER:

Professor of the Department of Fundamental and Medical and Preventive Disciplines  I. Savytskyi, Doctor of Medicine, Professor;  
Senior teacher of the department of fundamental and medical and preventive disciplines  S. Ukrainska;

REVIEWER:


Professor of the Department of Fundamental and Medical and Preventive Disciplines  M. Vergolyas, Doctor in Biology, Professor

Guarantor of EP  A. BONDARENKO

The working program of the academic disciplines is reviewed and approved by the Department of Fundamental, Medical and Preventive Disciplines, protocol No. 1 dd. August 25, 2023.

Head of the Department of Fundamental, Medical and Preventive Disciplines, PhD in Biology, Associate Professor  Victoria KOVALENKO

The program is reviewed and approved by the Academic Council of the European Medical School, protocol No. 1 dd. August 29, 2023.

Chair of the Academic Council  
of the European Medical School  
Ph.D in Medicine,  
associate professor  Yevhenii SIMONETS

## INTRODUCTION

**The study program of the academic discipline "Physiology"** was developed in accordance with Standard of higher education of Ukraine for the training of specialists of the second (master's) level, field of knowledge 22 - "Health care", specialty - 222 "Medicine", educational qualification "Master of Medicine", professional qualification "Doctor".

### **Description of the academic discipline**

The study program of the discipline "Physiology" is intended for higher medical institutions of education of Ukraine in accordance with the requirements of the credit-transfer system of the organization of the ECTS educational process, based on a combination of learning technologies by sections and credit assessment credits - units of measurement of the student's educational load necessary for mastering the discipline or its section .

In accordance with the curriculum for training specialists of the second (master's) level of higher education in the field of knowledge 22 "Health care", the subject "Physiology" is taught in the 2nd year of study.

For the study of the discipline "Physiology" 9 credits (270 hours) are provided, of which 145 classroom hours, 125 - independent work.

### **Informative description educational disciplines**

Name indicators	Branch of knowledge, specialty, level higher education	Characteristic educational disciplines	
		daytime form teaching	
<b>Number loans – 9</b>	Branch knowledge: 22 "Protection health"	Normative	
		Year preparation	
	Specialty: 222 "Medicine"	2nd	
		Semester	
<b>Total hours —270</b> The total number of classroom hours is 145	Educational qualification level: master	III	IV
		Lectures	
Weekly load: classrooms III semester - 4 classrooms IV semester - 5	Educational qualification level: master	8 p.m	8 p.m
		Practical	
		45 hours	60 hours
		Independent work	
		55 hours	70 hours
		Kind control	
		test	exam

Physiology as educational discipline:

- forms a set of knowledge about the function of human organs and systems and their

regulation mechanisms.

- is based on students' study of medical biology, medical chemistry, human anatomy, histology, cytology and embryology and integrates with these disciplines;
- integrates with further disciplines of pathological physiology, propaedeutics of internal diseases, therapy, surgery, medical rehabilitation;
- lays the foundations of a healthy lifestyle and prevention of dysfunctions in the process of life.

## 1. GOAL STUDY EDUCATIONAL DISCIPLINES

**The subject** of study of the academic discipline is the functions of a living organism, their connection with each other, regulation and adaptation to the external environment, origin and formation in the process of evolution and individual development of an individual.

**Interdisciplinary connections:** the academic discipline is based on the students' study of medical biology, Latin language, medical and biological physics, medical chemistry, biological and bioorganic chemistry, morphological disciplines and is integrated with these disciplines; lays the foundations for students to study pathophysiology, pathomorphology, deontology and propaedeutics of clinical disciplines, which involves the integration of teaching with these disciplines and the formation of skills to apply knowledge of physiology in the process of further education and professional activity; lays the foundations of a healthy lifestyle and prevention of structural and functional impairment in life.

**The purpose** of teaching the academic discipline "Physiology" is to study the functions of various cells, tissues, organs and systems in general with the aim of using the acquired knowledge in the study of the following medical disciplines and in future professional activities. Presupposes an understanding of the concept of health, a healthy lifestyle and the prevention of functional disorders in the process of life.

Competences and learning outcomes, the formation of which contributes to the discipline. The discipline ensures that students acquire the following competencies :

<b>general competence (ZK)</b>	
<b>ZK 1.</b>	Ability to abstract thinking, analysis and synthesis.
<b>ZK 2.</b>	Ability to learn and master modern knowledge.
<b>ZK 3.</b>	Ability to apply knowledge in practical situations.
<b>ZK 4.</b>	Knowledge and understanding of the subject area and understanding of professional activity
<b>ZK 5.</b>	Ability to adapt and act in a new situation
<b>ZK 6.</b>	Ability to make informed decisions
<b>ZK 7.</b>	Ability to work in a team
<b>ZK 8.</b>	Ability to interpersonal interaction
<b>ZK 10.</b>	Ability to use information and communication technologies
<b>ZK 11.</b>	Ability to search, process and analyze information from
<b>ZK 12</b>	Determination and persistence of delivered tasks and taken responsibilities
<b>Professionals competence (FC)</b>	
<b>FC 1.</b>	Ability to collect medical information about the patient and analyze clinical data

<b>FC 2</b>	Ability to determine the necessary list of laboratory and instrumental studies and evaluate their results
<b>FC 3</b>	Ability to establish preliminary and clinical diagnosis of the disease
<b>FC 6</b>	Ability to determine the principles and nature of treatment and disease prevention
<b>FC 11.</b>	Ability to solve medical problems in new or unfamiliar environments in the presence of incomplete or limited information, taking into account aspects of social and ethical responsibility.
<b>FC 23</b>	Ability to develop and implement scientific and applied projects in the field of health care.
<b>FC 24</b>	Adherence to ethical principles when working with patients and laboratory animals
<b>FC 25</b>	Adherence to professional and academic integrity, to be responsible for the reliability of the obtained scientific results
<b>Software the results teaching (PRN)</b>	
<b>PRN 1.</b>	Have thorough knowledge of the structure of professional activity. Be able to carry out professional activities that require updating and integration of knowledge. To be responsible for professional development, the ability for further professional training with a high level of autonomy
<b>PRN 2.</b>	Understanding and knowledge of basic and clinical biomedical sciences, on level sufficient for solving professional tasks in the field of health care
<b>PRN 3</b>	Specialized conceptual knowledge, which includes scientific achievements in the field of health care and is the basis for conducting research, critical understanding of problems in the field of medicine and related interdisciplinary problems.
<b>PRN 4</b>	Identify and identify leading clinical symptoms and syndromes (according to list 1); according to standard methods, using preliminary data of the patient's history, data of the patient's examination, knowledge about the person, his organs and systems, establish a preliminary clinical diagnosis of the disease (according to list 2). .
<b>PRN 5</b>	Collect complaints, history of life and diseases, evaluate psychomotor and physical development of the patient, state of organs and systems of the body, based on the results of laboratory and instrumental studies, evaluate information regarding the diagnosis (according to list 4), taking into account the age of the patient.
<b>PRN 21.</b>	to search necessary information in professional literature and databases data others sources , analyze , evaluate and apply this one information .

**Upon completion of studying the discipline "Physiology", students should know :**

- the mechanism of formation of the state of physiological functions of the body, its systems and organs;
- age-related features of body functions and their regulation;
- know the parameters and draw conclusions about the mechanisms of nervous and humoral regulation of the physiological functions of the body and its systems;
- the state of human health under various conditions based on physiological criteria;

**Upon completion of studying the discipline "Physiology", students should be able to:**

- interpret the mechanisms and regularities of the functioning of excitatory structures of the body;
- to analyze the state of sensory processes in the maintenance of human life;
- explain the physiological basis of the methods of researching body functions;
- to explain the mechanisms of the body's integrative activity

## **2. CONTENT OF THE ACADEMIC DISCIPLINE**

### **Chapter 1. "Introduction to physiology. Physiology of excitatory structures".**

#### **Topic 1.** Subject and tasks of physiology. Methods of physiological research.

General information about the discipline. Physiology as a scientific basis of medicine about body functions, ways of maintaining health and working capacity. The value of physiology in training a doctor. Methods of physiological research. Basic concepts of physiology. Levels of the structure of the human body. The unity of the organism and the external environment. Physiological characteristics of functions, their parameters. Age and sex characteristics of functions. Functions of cells, tissues, organs, organism as a whole. Homeostasis and homeokinesis .

#### **Topic 2.** Resting potential of nerve and muscle fibers.

Modern understanding of the structure and functions of cell membranes. The main differences in the chemical composition of the extracellular fluid and the intracellular environment. Mechanisms of transport of substances through the cell membrane. The concept of membrane potential and resting potential. Methods of recording resting potential, physical characteristics, mechanism of origin. The physiological role of resting potential.

#### **Topic 3.** Action potential of nerve and muscle fibers.

Action potential, its physical and physiological characteristics. The structure and main properties of ion channel proteins involved in the development of PD. Ionic mechanisms of the formation of the main phases of PD. Excitability, its changes during the development of PD.

**Topic 4.** Mechanisms of electrical stimulation of excitable structures and conduction of excitation along nerve and muscle fibers.

Methods of electrical stimulation of nerve and muscle fibers. Parameters of electric current that determine its ability to cause excitation. Passive and active electrical potentials caused by electrical stimulation. Changes in the excitability of nerve and muscle fibers caused by electric current. The mechanism of conduction of a nerve impulse along unmyelinated and myelinated fibers. Laws of conduction of excitation along nerve fibers. Factors determining the speed of action potential conduction along nerve fibers. Characteristics of the type of fibers. Structure and classification of synapses. The mechanism of transmission of excitation through the neuromuscular synapse.

#### **Topic 5.** Contraction of skeletal and smooth muscles.

Structural organization of the contractile apparatus of muscles. The concept of a motor unit. Modern concept of the mechanism of contraction of muscle fibers. Stages of the reduction process. Chemistry and energy of muscle contraction. The main features of the contractile apparatus and the functioning of smooth muscles. Physiological

characteristics of muscle contraction: load, force, duration, speed, work, fatigue. Electromyography. Dynamometry. Determination of absolute strength, performance and fatigue of muscles.

## **Chapter 2. "Nervous regulation of body functions."**

**Topic 6.** General patterns of nervous regulation of functions. Excitation and inhibition in the central nervous system.

The main features of nervous regulation of functions. Structure and functions of a neuron. Neuroglia, its functional significance. Concept of reflexes, their classification. Reflex arc, functions of its individual elements. Properties of nerve centers. Coordination of reflex activity. CNS synapses, their structure, information transmission mechanisms. Classification of mediators, their general characteristics. Characteristics of excitatory and inhibitory postsynaptic potentials. Central inhibition, its types, mechanisms, significance. The role of inhibitory neural circuits in the emergence of central inhibition.

**Topic 7.** The role of the spinal cord in the regulation of body functions.

Analysis of sensory information by the spinal cord. Motor systems of the spinal cord, their organization and coordination mechanisms (convergence, divergence, types of motoneuron inhibition - reverse, reciprocal). Physiological characteristics of proprioceptors. Muscle spindles (stretch receptors): their structure and functions. Stretch reflexes (myotatic), their reflex arcs, functions of the gamma loop. Activation of alpha and gamma motoneurons supraspinal motor centers. The role of stretch reflexes in the regulation of muscle tone (tonic myotatic reflexes) and muscle length (phasic myotatic reflexes). The clinical significance of the study of myotatic reflexes. Golgi tendon receptors, their functions, reflexes from tendon receptors, their reflex arcs, physiological significance. Flexion and extensor skin-muscle reflexes. Study of clinically important reflexes. Functional capabilities of the isolated spinal cord. Transverse section of the spinal cord and spinal shock. Conductive function of the spinal cord, its role in the regulation of motor functions. The role of the hindbrain in the regulation of motor functions. Descending motor pathways, their role in regulating the activity of alpha and gamma motoneurons. The role of the hindbrain in ensuring antigravity posture (vestibular nuclei and reticular formation), mechanisms of decerebrate rigidity. Tonic labyrinthine reflexes. Vestibular receptors of the sac and uterus, their role in the regulation of tone and posture. Tonic neck reflexes.

**Topic 8.** The role of the brain in the regulation of body functions.

The role of the midbrain in the regulation of motor functions. Motor reflexes of the middle brain: static and stato-kinetic. Righting reflexes (labyrinthine, cervical). Head rotations and receptors of the semicircular canals, their physiological role in maintaining the equilibrium posture during movement with acceleration. Vestibular mechanisms of eyeball stabilization, nystagmus. The role of the midbrain in the regulation of stereotyped involuntary movements. Approximate reflexes. The role of the reticular formation in the regulation of motor functions. Descending and ascending influences of the reticular formation of the brainstem. The role of the basal nuclei in the regulation of motor functions. Functional organization and connections of basal nuclei (caudate nucleus, shell and globus pallidus). The role of the basal nuclei in the regulation of muscle tone and complex motor acts, in the organization and implementation of motor programs, their

interaction with the subthalamic nucleus and the substantia nigra, and other structures. Neurotransmitters in the system of basal nuclei, their physiological role. Cycles of the shell and caudate body. Clinical manifestations in damaged basal nuclei, their physiological mechanisms. The role of the cerebellum in the regulation of motor functions. Functional-structural organization of the cerebellum, its afferent and efferent connections, their physiological role. Functional organization of the cerebellar cortex. Interaction between the cerebellar cortex and the cerebellar and vestibular nuclei. The role of the cerebellum in programming, initiation and control of movements. Cerebellum and learning. Consequences of removal or damage to the cerebellum occurring in humans, their physiological mechanisms. Peculiarities of the geniculate structure of the cortex of the large hemispheres. Functions of the cortex of the large hemispheres. The works of I.M. Sechenov on the study of brain reflexes. Electroencephalography. The role of motor areas of the cortex in the regulation of motor functions. The primary motor zone of the cortex, its functional organization and role in the regulation of motor functions. Premotor and supplementary motor areas of the cortex, their organization and role in the regulation of motor functions. Afferent connections of the motor cortex. Descending pathways: corticonuclear, corticospinal - lateral, ventral, their role in regulating the functions of the muscles of the axial skeleton, proximal and distal parts of the limbs. Human locomotion, their regulation. Movement programming. Functional structure of voluntary movements. Study of functional asymmetry of the cortex of the large hemispheres. Age-related changes in motor functions.

**Topic 9.** Nervous regulation of vegetative functions.

Structural and functional features of the autonomic nervous system. Sympathetic, parasympathetic and metasympathetic department. Peculiarities of the reflex arc of the autonomic reflex. Vegetative ganglia, their functions. Preganglionic and postganglionic fibers. The mechanism of excitation transmission in vegetative ganglia. Mediators and blockers of the autonomic nervous system. Influence of sympathetic, parasympathetic and metasympathetic departments on organs. Classification of autonomic reflexes. Reflex arc of the autonomic reflex. Research and use of autonomic reflexes in practical medicine. Central regulation of visceral functions. Integrative centers of regulation of visceral functions. The role of the brain stem. Hypothalamus, its afferent and efferent connections. Functions of the hypothalamus in the regulation of visceral functions.

**Chapter 3. "Humoral regulation of body functions."**

**Topic 10.** General patterns of humoral regulation of vegetative functions.

Factors of humoral regulation, their characteristics and classification. Contour of humoral regulation, the role of feedback in regulation. Relationship between nervous and humoral regulation. Structural and functional organization of the endocrine system. Endocrine glands, endocrine cells, their hormones and significance. Basic mechanisms of hormone action. Membrane and intracellular receptors, G-proteins, secondary mediators (cAMP, cGMP, Ca<sup>2+</sup>, IP<sub>3</sub>, DAG, NO, etc.), their role. Regulation of hormone secretion. Hypothalamic-pituitary system. Functional connection of the hypothalamus with the pituitary gland. Neurosecretions of the hypothalamus. The role of liberins and statins.

**Topic 11.** The role of hormones in the regulation of physical, mental, and sexual development.



Adenohypophysis , its hormones, their effects. The role of somatotropin (STH) and somatomedins in ensuring the processes of growth and development. Metabolic effects of somatotropin . Contour of regulation of secretion of STH, circadian rhythms. Metabolic effects of STH. Thyroid gland, its hormones ( iodothyronine ). Mechanisms of action of iodothyronines on target cells, influence on the state of mental functions, growth and development processes, metabolic processes, state of visceral systems, etc. The circuit of regulation of thyroxine (T4) and triiodothyronine (T3) synthesis and secretion . The role of other hormones affecting the processes of normal growth (insulin, steroid hormones of the gonads , cortisol ). Gonads. Sexual differentiation, development and functions of the reproductive system. The period of puberty. Male reproductive system, its structure and functions. Spermatogenesis. Endocrine function of the testicles, regulation of the function of the testicles, the circuit of regulation with the participation of the hypothalamohypophyseal system. Erection and ejaculation , hormonal and nervous mechanisms of regulation. Female reproductive system, its structure and functions. Ovarian hormones, their role, regulation of ovarian function. Monthly cycle. Pregnancy. Hormones of the placenta. Lactation. Age-related features of endocrine gland functions.

**Topic 12.** The role of hormones in the regulation of homeostasis and adaptation of the body to the action of stress factors.

Pancreatic hormones (insulin, glucagon , somatostatin ) and their effects on metabolism and blood glucose concentration. The circuit of hormonal regulation of maintenance of constancy of glucose concentration in the blood. Calcium balance in the body and hormones that regulate calcium and phosphate homeostasis: parathyroid hormone , calcitonin , 1,25 (OH)<sub>2</sub> D<sub>3</sub>. Influence of other hormones on calcium metabolism ( glucocorticoids , somatotropin , IGF-1, thyroid hormones, estrogens , insulin). The role of vasopressin, oxytocin . Hormones of the medulla of the adrenal glands ( catecholamines ), their role in the body, regulation of secretion. Hormones of the adrenal cortex , contours of regulation of their secretion, circadian rhythms of glucocorticoid secretion , their effects and mechanisms of action on target cells. The concept of stress and stress factors. Types of adaptation to stress factors. General adaptation syndrome (H. Selye ). The role of the sympatho-adrenal system in adaptation. The role of adrenal cortex hormones ( glucocorticoids , mineralocorticoids ), pituitary gland, thyroid hormones (thyroxine, triiodothyronine ), vago- insular system in ensuring non-specific adaptation of the body to stress factors.

#### **Chapter 4. "Physiology of analyzers and VND"**

**Topic 13.** Sensory systems.

The concept of sensor systems (analyzers). The importance of sensory systems in learning about the world. Systemic nature of perception. Structural and functional organization of the sensory system. Receptors: classification, main properties, excitation mechanisms, functional lability. Regulation of receptor function. Concept of receptive field and reflexogenic zones. Methods of studying the excitability of receptors. Conductive department of the sensory system. Conductive paths: specific and non-specific channels of information transmission. Participation of the structures of the spinal cord, brain stem, and thalamus in the conduction and processing of afferent excitations. The thalamus as a collector of afferent pathways. Functional characteristics of specific

(relay, associative) and nonspecific nuclei of the thalamus. Cortical department of the sensory system. Localization of afferent functions in the cortex. Processes of higher cortical analysis and synthesis of afferent excitations. Interaction of sensory systems. Coding of information and its processing in various departments of the sensory system. Physiological basis of methods of research of sensory systems. Age-related changes in sensory systems. Structural and functional organization of the somato-sensory system (cutaneous and proprioceptive sensitivities ). Study of the spatial threshold of tactile sensitivity. Physiological basis of pain. Nociception , physiological characteristics and classification of nociceptors (Ch. Sherrington ). Nociceptive or pain system, its structural and functional organization, leading pathways and levels of information processing. Physiological meaning of pain. Antinociceptive or analgesic system, its structural and functional organization, opiate and non-opiate mechanisms, physiological role. Physiological basis of analgesia. Structural and functional organization of the visual sensory system, main and auxiliary structures. Receptor apparatus: rods and cones. Photochemical processes in receptors under the action of light, receptor potential. Sight. Refraction and accommodation. Conductive and cortical departments of the visual sensory system. Analysis of information at different levels. Formation of a visual image. Modern ideas about color perception. The main forms of color perception disorders. Basic visual functions and physiological basis of their research methods. Structural and functional organization of the auditory sensory system, main and auxiliary structures. Sound-conducting, perceiving and analyzing structures. Conductive and cortical departments of the auditory sensory system. Central mechanisms of sound information analysis. Theory of sound perception. Binaural hearing. Structural and functional organization of the vestibular sensory system. Receptor, conductor and cortical departments, central analysis of information at different levels. Perception of the position of the head in space and the direction of movement.

#### **Topic 14.** Physiological bases of behavior.

Physiological bases of behavior. Innate (unconditioned-reflex) forms of behavior. Instincts, their importance for adaptive activity of the organism. Acquired (conditional-reflex) forms of behavior, their importance for the adaptive activity of the organism. Patterns of formation and storage of conditioned reflexes (I.P. Pavlov). Inhibition of conditioned reflexes. Types of braking. Physiological significance. Learning and memory, its types, mechanisms. Sleep. Its phases. Mechanisms of sleep development. The importance of sleep for the body. Needs and motivations, their physiological mechanisms, role in the formation of behavior. Functional behavior system. The structure of a complete behavioral act according to P.K. Anokhinim. Emotions, their types, formation mechanisms, biological role. Theories of emotions. Types of higher nervous activity, their classification, physiological bases, research methods. The role of education. Types of the nervous system in humans, methods of their research. Thinking. The role of brain structures in the thinking process. Consciousness. The concept of signaling systems. Comparative characteristics of the signals of the I and II signal systems. Forms of speech. Formation of the II signaling system in ontogenesis. Language functions. Relationships between the 1st and 2nd signaling systems. Language centers. Functional asymmetry of the human brain. Types of higher nervous activity of people depending on the level of

functioning of signaling systems. The main provisions of the teaching of I.P. Pavlov on the types of higher nervous activity of humans and animals. Methods of determining the properties of nervous processes.

### **Chapter 5. "Physiology of the blood system."**

#### **Topic 15 . Physico-chemical properties of blood.**

General characteristics of liquid media. Physiological blood system. Its structure. General characteristics and composition of peripheral blood. The main functions of the physiological blood system. Functional significance of water and blood plasma electrolytes. Blood plasma proteins. Their composition and main functions. Basic physical and chemical properties of blood: osmotic pressure, density, viscosity, reaction of blood. Erythrocyte sedimentation rate (ESR). Factors affecting this indicator. Study of ESR in the clinic, evaluation of the indicator.

#### **Topic 16. Properties and functions of erythrocytes.**

General characteristics of erythrocytes. Their function. Hematocrit. Factors on which its value depends. Osmotic resistance of erythrocytes. Its meaning. Hemolysis of erythrocytes. Types and mechanisms of hemolysis. Hemoglobin as the main component of the erythrocyte. Structure of hemoglobin. Research and assessment of the hemoglobin content in the blood and the number of erythrocytes. Calculation of color indicator and oxygen capacity of blood. Basic forms and compounds of hemoglobin. Color indicator, its definition. Mechanisms of formation and physiological destruction of erythrocytes. Regulation of the content of erythrocytes in peripheral blood.

#### **Topic 17. Protective properties of blood. Blood groups.**

Leukocytes, their distribution in the body. Quantitative and qualitative composition of peripheral blood leukocytes. The main functions of certain types of leukocytes. Mechanisms of phagocytosis. Characteristics of non-specific and specific immunity. Regulation of leukopoiesis and activity of leukocytes. The concept of blood groups. Agglutinogens and agglutinins. Characteristics of blood groups of the AB0 system. Modern ideas about blood groups of the AB0 system. Characteristics of blood groups of the CDE system. Determination of blood groups in the ABO system and the Rhesus factor using standard serums and tsoliclons . Blood transfusion ( hemotransfusion ), its stages.

#### **Topic 18. Hemostasis.**

The concept of hemostasis and its two main mechanisms. The structure of the hemostasis system. The role of the vascular wall and platelets in hemostasis. Mechanisms of vascular and platelet hemostasis: spasm of arterioles, adhesion, platelet aggregation, release reaction, thrombus consolidation. Mechanisms of coagulation hemostasis. Blood coagulation system. Phases of blood clotting, their essence. Characteristics of the blood anticoagulant system. Characteristics of the fibrinolysis system. Regulation of blood clotting. Physiological basis of methods of research of hemostasis. Age-related changes in the hemostasis system. Mechanisms of maintaining the liquid state of the blood.

### **Chapter 6. "Physiology of the cardiovascular system."**

#### **Topic 19 . General characteristics of the circulatory system.**

General characteristics of the circulatory system, its structure. Functional departments of the circulatory system. Basic and additional functions of the circulatory system. Functional properties of heart muscle. Comparative characteristics of atypical and

typical muscle fibers. Conductive system of the heart, its meaning. Mechanisms of spontaneous pulse generation in the conductor system. The law of "gradient automatism". Conduction of impulses through the conduction system to the working myocardium. Functional properties of contractile muscle fibers of the heart. Action potential of contractile myocytes . Ionic mechanisms of the emergence of its main phases. Absolute and relative periods refractoriness in the myocardium. Their physiological significance. Mechanisms of electromechanical coupling in cells of the contracting myocardium. Features of the actual contraction and relaxation processes in myocytes .

**Topic 20.** Mechanical work of the heart. Phase analysis of the cardiac cycle.

Structural and functional elements of the heart as a pump. Functions of atria and ventricles. Valve apparatus of the heart, its functions. The concept of heart tones and methods of their study. Study of the properties of the apical impulse and heart sounds by the method of auscultation. Modes of contractions of the heart and types of loads on it. The concept of the cycle of cardiac activity. Phase structure of the cardiac cycle. Characteristics of ventricular systole: periods of tension and expulsion. Characteristics of ventricular diastole: periods of relaxation and filling. Systolic and minute volumes of blood, cardiac index.

**Topic 21.** Registration and analysis of ECG.

Conduction of electrical potentials from isolated muscle fibers, separate areas of the myocardium and the heart as a whole. Electrocardiogram elements (teeth, segments, intervals) and their characteristics. Electrocardiogram (ECG) registration methods. Research on the ECG of the main segments, intervals, teeth, duration of the cardiac cycle, heart rate, systolic index. Evaluation by ECG of the regularity of heart contractions, sources of excitation, conduction of the myocardium. Fundamentals of vector ECG analysis. The concept of the total instantaneous vector of the heart. ECG lead axes. Vector analysis of the origin of ECG waves. Electric axis of the heart. The method of its determination. Causes of deviation of the electrical axis of the heart under normal conditions.

**Topic 22.** Basics of hemodynamics. Patterns of blood movement in arterial and venous vessels.

Basic laws of hemodynamics. Total peripheral vascular resistance. Factors that ensure the movement of blood through vessels of high and low pressure. Linear and volume velocity of blood movement in different sections of the vascular bed. Reynolds number . Functional classification of blood vessels according to Folkov B. Pulse fluctuations of blood movement, volume and pressure in arterial vessels. Blood pressure: systolic, diastolic, pulse, average. Methods of measuring blood pressure. Concept of arterial pulse. Its main characteristics. Pulse wave propagation speed. Factors determining this indicator. Concept of microcirculation. The structure and functions of the microcirculatory channel. Mechanisms of metabolism between blood and interstitial fluid: diffusion, filtration - reabsorption, microvesicular transport.

**Topic 23.** Regulation of the activity of the heart, local and systemic blood circulation.

Myogenic mechanisms of heart regulation. Frank- Starling law . Immediate

mechanisms of heart adaptation to volume and resistance loads. The nature and mechanisms of the influence of the parasympathetic nervous system on the work of the heart. The nature and mechanisms of influence of the sympathetic nervous system on the work of the heart. The role of the metasymphetic nervous system in the regulation of heart activity. Intracardiac reflexes. The influence of factors of humoral regulation on the work of the heart. Peculiarities of mechanisms of microcirculatory vessel regulation . Myogenic , metabolic and histomechanical mechanisms of local blood circulation regulation. Concept of physiological arterial hyperemia. Nervous regulation of local blood circulation. Humoral mechanisms of local blood circulation regulation. Vascular tone and its regulation, nervous and humoral mechanisms. Regulation of systemic blood circulation. Cardiovascular center, its structure, afferent and efferent connections. The concept of a single hemodynamic center ( V.V. Frolkis ). The main reflexogenic zones, baroreceptors and chemoreceptors of the carotid sinus and aortic arch, their role. Reflexes from the receptors of the atria and large veins. Pressor and depressor reflexes. Interrelated mechanisms of nervous and humoral regulation of heart activity, vascular tone, and circulating blood volume during various adaptive reactions. Physiological prerequisites for blood pressure disorders. Nervous and humoral mechanisms of blood pressure regulation. Determination of the type of response of the cardiovascular system to physical exertion. Age-related features of blood circulation and its regulation.

### **Chapter 7. "Physiology of the respiratory system."**

**Topic 24.** General characteristics of the respiratory system. Study of external breathing.

Stages of breathing. The general structure and main functions of the external respiratory system. Functional characteristics of the structural elements of the external respiratory system: chest, respiratory muscles, pleural cavity, airways , lungs. Concept of transpulmonary , pleural and alveolar pressure. Elastic traction of the lungs. Surfactants , their significance. Biomechanics of breathing. Inhalation and exhalation mechanisms. Static indicators of lung ventilation. Concepts of lung volumes and lung capacities. Dynamic indicators of lung ventilation. Minute volume and lung capacity. Dynamic indicators of lung ventilation. Minute volume of breathing, its definition. Spirometry. Spirography.

**Topic 25.** Gas exchange in the lungs. Transport of gases by blood. Regulation of breathing.

Composition of inhaled, exhaled, alveolar air. The relative constancy of the alveolar air composition. The tension of gases dissolved in the blood. Partial pressure of gases ( $P_{CO_2}$ ,  $P_{O_2}$ ) in alveolar air. Mechanisms of gas exchange between inhaled air and alveolar gas mixture, between alveoli and blood in pulmonary capillaries. A property of the lung membrane. Diffusion capacity of the lungs. Relationship between pulmonary circulation and lung ventilation. Anatomical and physiological "dead space". Forms of oxygen transport by blood. Transport of oxygen physically dissolved in blood plasma. Its functional value. Transport of chemically bound oxygen. Functional characteristics of hemoglobin. The concept of Hüfner's number and the oxygen capacity of blood. Oxyhemoglobin dissociation curve. The functional value of the shape of this curve. The concept of shifting the oxyhemoglobin dissociation curve to the right and to the left.

Factors causing such changes. The Bohr effect, its functional significance. Forms of transport of carbon dioxide from tissues to lungs. Binding curves of carbon dioxide. The Haldane effect, its meaning. The concept of the respiratory center. Research methods of its localization. Concept of inspiratory and expiratory neurons. Localization and functional characteristics of groups of neurons that are part of the respiratory center. Mechanisms of autonomous rhythmic activity of the respiratory center in conditions of calm and increased breathing. The influence of mechanical factors on the activity of the respiratory center. Types of mechanoreceptors in the lungs. Goering-Breyer reflex. The influence of chemical factors on the activity of the respiratory center. Central and peripheral mechanisms of these influences. Assessment of lung tissue elasticity, small bronchial width and bronchial muscle tone using functional breathing tests.

### **Chapter 8. "Physiology of the digestive system."**

**Topic 26.** General characteristics of the digestive system. Digestion in the mouth and stomach.

Structure and functions of the digestive system. Alimentary canal and digestive glands. The main functions of the digestive system: secretion, motility, absorption. Digestion: its types (cavity, membrane, intracellular), main stages. Features of secretory cells, mechanisms of secretion, the role of calcium ions and cellular mediators in the secretory process. Basic principles and mechanisms of digestion regulation. Gastrointestinal hormones. Phases of secretion of the main digestive glands. Periodic activity of digestive organs. Motility of the alimentary canal. Features of the structure and functions of the smooth muscles of the alimentary canal. Physiological basis of the methods of researching the functions of the alimentary canal. Physiological basis of hunger and satiety. Food motivation, perception of the food center. The contour of the regulation of maintaining the stability of the content of nutrients in the internal environment. The value of the oral cavity as the initial department of the digestive system. Composition, properties and significance of saliva. Mechanisms and regulation of salivation. Mechanical processing of food. Mechanisms of chewing and swallowing. Taste analyzer, its structure and meaning. The importance of the stomach in digestion processes. Gastric juice, its composition, properties and values of the main components. Mechanisms of gastric secretion. Nervous and humoral mechanisms of gastric secretion regulation. Phases of gastric secretion. The influence of different food regimes on gastric secretion. Motor function of the stomach. Mechanisms of food transit from the stomach to the duodenum. Vomiting reflex, its causes and mechanisms.

**Topic 27.** Digestion in the intestines. The role of the liver and pancreas. Absorption in the gastrointestinal tract.

Pancreatic juice, its composition, properties and importance of the main components. The influence of various food substances on the secretion of pancreatic juice. Nervous and humoral mechanisms of regulation of pancreatic secretion. Bile, its composition, properties and significance of the main components. Mechanisms of bile secretion and regulation of this process. Protective (barrier and antitoxic), metabolic and hemodynamic functions of the liver. Intestinal secretion, composition and properties of intestinal juice, its role in digestion. Research methods. Regulation of intestinal secretion. Cavity and membrane hydrolysis of 18 food substances. Motor activity of the small

intestine, its role in digestion. Types of motility, its regulation. The role of the metasympathetic system in the regulation of the secretory and motor functions of the intestines. Digestion in the colon. The role of gut microflora. Colon motility, its regulation. Act of defecation. Absorption processes. Research methods. Absorption of substances in different departments of the alimentary canal, its mechanisms. Features of absorption of water, salts, carbohydrates, proteins, fats, vitamins, and other substances. Adjustment of suction.

## **Chapter 9. "Physiology of metabolism and energy. Thermoregulation".**

**Topic 28.** Exchange of substances and energy. Thermoregulation.

Physiological significance of proteins, fats and carbohydrates. Concept of nitrogen balance. Energy conversion in the body. Methods of studying energy exchange: direct and indirect calorimetry. The caloric equivalent of oxygen and the respiratory coefficient, their significance in metabolic studies. The concept of basic exchange. Factors affecting its value. Determination of the basic exchange according to the data of indirect calorimetry and the proper basic exchange according to the tables of Harris -Benedict. Specifically, the dynamic effect of food. Energy expenditure of the body during physical and mental activity. Physiological foundations of rational nutrition. Caloric coefficients of nutrients. The concept of core and shell as temperature zones of the body. Periodic fluctuations in body temperature, changes in body temperature under physiological conditions. Mechanisms of heat generation. The concept of contractile and non-contractile thermogenesis. Mechanisms of heat transfer. Environmental factors affecting heat transfer. Properties and physiological reactions of the body that determine the intensity of heat transfer. The center of thermoregulation, its structure and basic principles of functioning. Afferent and efferent links of thermoregulation.

## **Chapter 10. "Physiology of the excretory system."**

**Topic 29.** General characteristics of the allocation system. Regulation of kidney function.

The allocation system, its structure, functions. Excretory organs (kidneys, skin, lungs, alimentary canal), their participation in maintaining body homeostasis. Kidneys as the main organs of the excretory system. Nephron as a structural and functional unit of the kidney. Blood circulation in the kidney, its features. The main processes of urine formation: filtration, reabsorption, secretion. Filtering mechanisms, composition of primary urine. Filter speed adjustment. Reabsorption in tubules, its mechanisms. Rotary-counter-current multiple system, its role. Secretory processes in proximal and distal tubules and collecting tubules. Final urine, its composition, number. The coefficient of purification (clearance) and determination of the rate of filtration, reabsorption, secretion, the amount of renal plasma circulation and blood circulation. Regulation of kidney activity. Diuresis. Composition of primary and secondary urine. Methods of studying the excretory function of the kidneys. Involvement of kidneys in maintenance of nitrogen balance, parameters of homeostasis. Regulation of constancy of internal osmotic pressure, role of vasopressin. Mechanisms of thirst. Regulation of the constancy of the concentration of sodium, potassium ions, volumes of water and circulating blood in the body with the participation of the kidneys: the role of

the renin-angiotensin- aldosterone system, atrial natriuretic hormone. Regulation of the constancy of the concentration of calcium and phosphate ions with the involvement of the kidneys. The role of the kidneys in the regulation of the acid-base state of the internal environment. Urination and its regulation. Physiological basis of methods of research of kidney function. Assessment of clinical urinalysis. Determination and evaluation of glomerular filtration rate, water reabsorption rate, maximum glucose reabsorption rate, and renal excretion pathways. Age-related changes in urine formation and urination.

### 3. The structure of the academic discipline

Names sections and topics	Number hours				
	ever ythi ng oh	in ago number of			
		l	p/r	l/ p	ot he rs d.
<b>Section 1. Introduction to physiology Physiology exciting structures</b>					
Topic 1. Subject and tasks of physiology. Physiological methods of research	7	2	3		4
Topic 2. Potential calmness nervous and muscle fibers.	7	2	3		4
Topic 3. Potential actions of nerves and muscular fibers	9	2	3		4
Topic 4. Mechanisms of electrical irritation of excitable structures.	9	1	3		5
Topic 5. Abbreviation skeletal and smooth ones muscles	9	1	3		5
<b>Section 2. Nervous regulation of functions body</b>					
Topic 6. Excitation and braking in the central nervous system.	9	2	3		4
Topic 7. Role dorsal brain in regulation functions.	9	1	6		4
Topic 8. Role main brain in regulation functions.	9	1	6		4
Topic 9. Nervous regulation vegetative functions.	9	2	3		5
<b>Section 3. Humoral regulation of functions body</b>					
Topic 10. Humorous regulation vegetative functions.	9	2	3		4
Topic 11. The role of hormones in the regulation of physical, mental, sexual development	9	1	3		4
Topic 12. The role of hormones in the regulation of homeostasis and adaptation body to the action of stressful factors.	12	1	6		5
<b>Section 4. Physiology analyzers and GNI</b>					
Topic 13. Sensory systems.	9	1	3		5
Topic 14. Physiological foundations behavior	9	1	3		4
<b>Section 5. Physiology blood system</b>					
Topic 15. Physico-chemical properties of blood	9	1	3		5
Topic 16. Properties and functions erythrocytes	9	1	3		4
Topic 17. Protective properties of blood. Groups of blood	9	1	3		4
Topic 18. Hemostasis.	9	1	3		4
<b>Section 6. Physiology cardiovascular systems</b>					
Topic 19. General characteristic systems blood circulation	11	2	3		5
Topic 20. Mechanical work hearts	9	1	3		4
Topic 21. Registration and analysis EKG.	9	1	3		4
Topic 22. Movement of blood in arterial and venous vessels	9	2	3		5



Topic 23. Regulation activity hearts, local and systemic blood circulation	9	2	6			4
<b>Section 7. Physiology respiratory system</b>						
Topic 24. Research external breathing.	9	1	3			4
Topic 25. Gas exchange in lungs Transport gases by blood	9	1	3			4
<b>Section 8. Physiology systems digestion</b>						
Topic 26. Digestion in oral cavity and stomach	9	1	3			4
Topic 27. Digestion in intestines The role of the liver and pancreatic glands Absorption in gastrointestinal tract	9	1	3			5
<b>Section 9. Physiology exchange substances and energy Thermoregulation</b>						
Topic 28. Physiology of metabolism and energy. Thermoregulation.	14	2	6			4
<b>Section 10. Physiology systems selection</b>						
Topic 29. Regulation of work kidney	12	2	6			4
<i>That's all hours</i>	<b>270</b>	<b>40</b>	<b>105</b>			<b>125</b>

#### 4. Topics of lectures

Noz.p	The topic of the lecture	Mrhours
1.	Introduction in course physiology. Excitable fabrics Biopotentials .	2
2.	General principles of biological regulation. Molecular and biological principles modern physiology.	2
3.	Nervous regulation Principles coordination reflex activity Excitation and inhibition in the central nervous system.	2
4.	Role different levels central nervous system in regulations motor functions. Role dorsal brain in regulations motor functions. The role of the trunk brain in regulations motor functions.	1
5.	Role the front brain and cerebellum in regulations motor functions, system activity body	1
6.	Sensory systems. Zorova and auditory sensory systems.	2
7.	Somatosensory system. Physiological foundations pain and anesthesia.	1
8.	Higher nervous activity. Processes formation and braking conditioned reflexes. Memory. Physiological bases of behavior. The role of needs and motivations and emotions	1
9.	Role ANS in regulations visceral functions.	2
10.	Physiological foundations humoral regulations visceral functions. Intracellular signaling .	2
11.	The role of endocrine glands in the regulation of physical, mental and sexual body development.	1
12.	Role endocrine glands in regulations homeostasis, non-specific adaptation body	1
13.	Fatigue and adaptation.	1
14.	Physiological foundations energy exchange Thermoregulation.	1
15.	General characteristic blood system. Blood as means transport and internal environment body Physiological properties erythrocytes Physiological basics of hemotransfusiology .	1
16.	Vascular and thrombocytic and coagulation hemostasis Protective functions of blood Role anticoagulants, plasmins .	1
17.	System blood circulation	1
18.	Physiological properties cardiac muscle	1
19.	System breath. The main ones stages breath.	2

20.	Mechanisms regulation breath.	1
21.	Pumping function hearts	1
22.	Regulation activity hearts	2
23.	Role vessels in blood circulation Laws hemodynamics.	2
24.	Regulation systemic and regional blood circulation	1
25.	System digestion.	1
26.	Digestion in oral cavity.	1
27.	Physiological foundations food.	1
28.	Digestion and absorption in stomach and intestines	2
29	System selection	2
	<b>TOGETHER</b>	<b>40</b>

## 5. Topics of practical classes

Noz.p	TOPIC	K-t hours
1.	The subject and tasks of physiology. Methods of physiological research. Studies of irritability and excitability and nerve and muscle fibers.	3
2.	Study of conduction of excitation by nerve fibers and through the neuromuscular synapse. Study of PD of intact nerves and muscles.	3
3.	Study of the mechanisms of skeletal muscle contraction. Physiological properties of smooth muscles. Myokines , their physiological significance. Study of physical development. Practical skills in the physiology of excitatory structures.	3
4.	General characteristics of biological regulation. Study of the reflex arc.	3
5	Study of excitation and inhibition processes in the central nervous system (CNS).	3
6.	Study of the role of the spinal cord and brain stem in the regulation of motor functions of the body.	3
7.	Study of the role of the forebrain and cerebellum in the regulation of motor functions of the body. Regulation of systemic activity of the body. Practical skills in the physiology of the central nervous system.	3
8.	Research of the somato-sensory system. Pain and antinociception .	3
9.	Research of visual and auditory sensory systems.	3
10.	Physiological bases of behavior. Study of formation and inhibition conditioned reflexes. Study of GNI types. Study of the role of motivations and emotions in behavioral reactions.	3
11.	Practical skills in the physiology of sensory systems and higher integrative functions.	3
12.	Study of mechanisms of nervous regulation of visceral body functions.	3
13.	Humoral regulation and the role of endocrine glands in the regulation of visceral body functions.	3
14.	Study of the role of hormones in the regulation of physical, mental and sexual development.	3
15.	Study of the role of hormones in the regulation of homeostasis and adaptation of the body to the action of stress factors.	3
16.	Study of mechanisms of energy exchange and thermoregulation.	3
17.	Practical skills in the physiology of the endocrine system, energy metabolism and thermoregulation.	3

18.	Physiology of the blood system. Study of physical and chemical properties of blood. Study of the number of erythrocytes and hemoglobin in the blood.	3
19	Study of group membership of blood. Physiological foundations of hemotransfusiology .	3
20.	Research of the subsidence and anti-seizure system . Study of the protective properties of blood against foreign influences.	3
21.	Practical skills in the physiology of the blood system.	3
22.	Respiratory system. Study of external breathing.	3
23.	Study of diffusion and transport of gases in the blood. Study of Breathing regulation. Practical skills in the physiology of the respiratory system.	3
24.	Physiology of the cardiovascular system. Study of the physiological properties of the heart muscle.	3
25.	Study of the dynamics of cardiac excitation. Registration and analysis of the electrocardiogram.	3
26.	Study of the pumping function of the heart. Study of the regulation of heart activity.	3
27.	Study of blood pressure in humans. The role of blood vessels in blood circulation. Laws of hemodynamics.	3
28.	Study of regulation of blood circulation. Lymph circulation	3
29.	Peculiarities of regional blood circulation and its regulation. Practical skills in the physiology of the cardiovascular system.	3
30.	Digestive system. Study of digestion in the oral cavity. The role of taste and smell sensory systems. Secretory function of salivary glands.	3
31.	Study of digestion in the stomach. Study of digestion in the duodenum.	3
32.	Studies of digestion in the intestines. Features of motility and absorption. Practical skills in the physiology of digestion.	3
33.	Study of the mechanisms of urine formation. Inseparable functions of the kidneys.	3
34.	Research on the participation of kidneys in maintaining homeostasis and homeokinesis . Practical skills in the physiology of the excretory system.	3
35.	Preparation for the final control and exam	3
	<b>TOGETHER:</b>	<b>105</b>

## 6. Independent work

No	Types, content of independent work	Mr. hours
1.	Preparation for practical classes – theoretical preparation and development of practical skills	23
2.	Know the subject and tasks of physiology, methods of physiological research. Be able to describe the general principles of the structure of biomembranes . Master the ability to draw a diagram: "Types of membrane transport" and explain it. Give examples of different types of passive and active transport. Interpret the concepts of "excitability" and "arousal".	3
3.	Be able to describe the mechanism of formation of resting potential; explain the role of active and passive transport in the formation of resting potential; carry out rest potential calculations.	3

4.	To master the ability to describe the method of preparation of isolated nervous frog muscle preparation, electrical stimulation of this preparation and registration of muscle contractions.	3
5.	Be able to explain and analyze the mechanisms and regularities of conduction of excitation through neuromuscular synapses and the possibilities of blockade of neuromuscular muscle transmission.	3
6.	Master the technique of recording single and tetanic contractions. To master the ability to explain the mechanisms of coupling excitation and contraction in skeletal muscle fibers, contraction and relaxation, to interpret the role of factors, from on which the force of muscle contraction depends.	3
7.	Be able to describe the mechanism of reflex regulation of functions and the role of the elements of the reflex arc. Master the ability to draw a myotatic arc , tendon , flexor, cross-extensor reflexes	3
8.	Be able to draw conclusions about the state of motor functions of the body - muscle tone, posture, locomotion, motor reflexes after a cross-section in an experiment at different levels of the central nervous system and when motor structures are damaged. Master the skills draw the leading pathways of the spinal cord.	3
9.	Be able to analyze the role of the cerebellum, basal nuclei and cerebral cortex in locomotion, evaluate the functions of the cortex in the formation of the systemic activity of the body. Master the primary skills of identifying symptoms of cerebellar damage.	3
10.	Be able to evaluate the influence of the sympathetic and parasympathetic system on the physiological body systems. Interpret the concepts of agonists and antagonists of neurotransmitters of the autonomic nervous system .	3
11.	Master the ability to draw a diagram of the relationship between the hormones of the hypothalamus, adenohypophysis , and neurohypophysis . Be able to determine the target organs of these hormones; draw a feedback scheme of hypothalamic-pituitary - thyroid , hypothalamic-pituitary-ovarian, etc. hormones. axes ; determine the localization of the pathology on the basis of these data.	3
12.	Explain the mechanism of synthesis and secretion of thyroid hormones, be able to interpret the concepts of hypothyroidism , hyperthyroidism , cretinism, myxedema, exophthalmos. Master the skills to explain the mechanism of regulation of calcium and phosphate levels in the blood, Trousseau syndrome , osteoporosis.	3
13.	Treat the endocrine functions of the pancreas, explain the metabolic effects of insulin, glucagon , somatostatin , pancreatic polypeptide; interpret the concepts of hyperglycemia, hypoglycemia, diabetes. Be able to explain the structure of the adrenal glands; interpret the effects of hormones of the glomerular , bundle, reticular zone of the cortex and medulla of the adrenal gland; establish a connection between glucocorticoids , catecholamines and stress; to explain the influence of glucocorticoids on the symptom of inflammation and the synthesis of eicosanoids . Be able to interpret the physiological and metabolic effects of catecholamines .	3
14.	Be able to explain the structure and fictitious organization of the visual sensory system; draw the path of rays in the case of normal vision, hypermetropia , myopia, explain the mechanism of accommodation, draw the leading paths of the visual analyzer.	3

15.	Be able to explain the structure and fictitious organization of the auditory sensory system; choose adequate methods of auditory analyzer research; explain the physiological basis of the sound-receiving apparatus, evaluate the functions of the receptor cells of the organ of Corti, depict schematically the structure of the auditory analyzer; evaluate the age characteristics of the auditory analyzer. Be able to evaluate the functions of ampullary and otolith vestibular receptors, draw a diagram of the leading paths of the vestibular analyzer.	3
16.	Be able to describe the general structure, the mechanism of the formation of impulses, the transmission of excitation along conductive paths; schematically depict the structure of olfactory, gustatory, and skin analyzers.	3
17.	Be able to analyze regulated parameters of homeostasis and explain the basics of behavior; to explain the mechanisms of the emergence of biological needs and motivation and their role in the formation of innate and acquired forms of behavior; to explain the physiological basis of methods of research of higher nervous activity: formation, preservation and inhibition of conditioned reflexes.	3
18.	Be able to explain the physiological basis of electroencephalography ; the mechanism of integrative activity of the body with the participation of the limbic system, to evaluate the mechanism of sensory and motor aphasia.	3
19.	Be able to explain the physiological basis of research methods for the types of the nervous system in humans; the mechanisms of the integrative activity of the new cerebral cortex during the formation of speech in a person and to assess its condition on the basis of physiological criteria; mechanisms of integrative activity of the brain, which determine the processes of consciousness, thinking, sleep and its types.	3
20.	Be able to interpret the concepts of the blood system, blood functions, functions of erythrocytes, leukocytes, and platelets. To know the theoretical basis of the technique of blood transfusion.	3
21.	Draw conclusions about the state of physiological functions of the body based on the number of erythrocytes, granular, agranular , leukocytes, platelets; hemoglobin level , color indicator, blood clotting time.	3
22.	Be able to interpret the causes of physiological leukocytosis, the shift of the leukocyte formula to the left, to the right. Evaluate the role of lymphokines and monokines . Explain the physiological mechanisms of chemotaxis and phagocytosis. Be able to explain the mechanisms of humoral and cellular immunity. Be able to compare the properties of T-lymphocytes and B-lymphocytes. To be able to predict the child's blood group based on the parents' blood group data, to interpret the mechanism of the development of Rhesus conflict.	3
23.	Be able to describe the plasma factors of blood clotting. Master the ability to draw a diagram of the main stages of blood clotting, a diagram of the external and internal mechanisms of prothrombinase activation . Be able to determine bleeding time and prothrombin index.	3
24.	Know and be able to interpret the functional properties of the heart muscle; describe the conducting system of the heart, its meaning; heart automation .	3
25.	Be able to analyze the cardiac cycle; to characterize the systole and diastole of the ventricles; know the main parameters and analyze systolic and minute blood volumes; cardiac index. Be able to listen to the tones of the heart.	3

26.	Be able to interpret the electrophysiological features of typical and atypical cardiomyocytes , explain the physiological basis of the electrocardiography method; interpret the formation of electrocardiogram elements from the point of view of vector theory; be able to determine based on the analysis of the electrocardiogram: what is the driver of the rhythm, whether the speed of conduction of excitation by the structures of the heart is normal, the position of the electrical axis of the heart.	3
27.	Be able to analyze changes in the tone of blood vessels under the influence of regulation mechanisms ( myogenic , nervous, humoral, local and central). Explain the role of the endothelium in the regulation of vascular tone. To analyze the age-related changes in vascular tone and the pumping function of the heart. Know the technique of measuring blood pressure in a person.	3
28.	Be able to analyze the physiological parameters of blood flow ; the nature and mechanisms of the influence of the sympathetic, parasympathetic and metasympathetic nervous system on the work of the heart; physiological prerequisites of blood pressure disorders and mechanisms of its regulation.	3
29.	Master the skills to explain the mechanisms of inhalation and exhalation, the function of the respiratory tract, the nature and role of elastic lung traction and surfactant ; explain the physiological basis of spirometry and spirometry.	3
30.	Master the ability to explain the mechanisms of breathing regulation. Be able to draw the oxyhemoglobin dissociation curve of an adult and a child, explain the mechanism of action of the factors affecting the curve. Explain the mechanism of artificial respiration.	3
31.	Master the ability to interpret the concept of the digestive system and the mechanisms of regulation of secretory, motor function and absorption; explain the physiological basis of the methods of researching the functions of the digestive system; explain the formation mechanism hunger and satiety motivations.	3
32.	Master the ability to interpret the concept of nervous and humoral regulation of pancreatic secretion; metabolic and hemodynamic functions of the liver. To acquire theoretical knowledge of research methods of regulation of intestinal secretion, motor activity of the small intestine; digestion in the large intestine. To be able to describe the features of absorption of water, salts, carbohydrates, proteins, fats, vitamins, and other substances in different departments of the alimentary canal, its mechanisms.	3
33.	Master the ability to draw conclusions about the intensity of metabolism based on the analysis of energy costs characterizing the main metabolism; draw conclusions about the daily energy expenditure of people of various professions and their correspondence to their energy needs in food rations: needs for proteins, fats, carbohydrates; analyze age-related changes in the body's energy expenditure and their regulation; explain the physiological basis of direct and indirect calorimetry methods.	3
34.	To be able to interpret the concepts of the secretion system, the mechanisms of homeostasis regulation with its participation based on the analysis of homeostasis constants; be able to determine and calculate the rate of glomerular filtration, explain the mechanisms of reabsorption and secretion; mechanisms of urine concentration, analyze the state of the kidneys based on the quantitative and qualitative state of urine.	3
	Together	125

## 7. TEACHING METHODS

According to the sources of knowledge, teaching methods are used: verbal - story, explanation, lecture, instruction; visual - demonstration, illustration; practical - practical

work, problem solving. According to the nature of the logic of knowledge, methods are used: analytical, synthetic, analytical-synthetic, inductive, deductive. According to the level of independent mental activity, the following methods are used: problem-based, searching, research.

1. Verbal methods: lecture, conversation;
2. Visual methods: illustration, demonstration
3. Practical methods: performing practical work and solving situational tasks of the "Step-1" format using interactive teaching methods ;
4. Students' independent work on understanding and assimilation of new material
5. Use of control and educational computer programs
6. Innovative teaching methods: business game, case method.

The types of training according to the curriculum are: lectures; practical training; independent work of students.

## 8. CONTROL METHODS

**Current control** is carried out on the basis of control theoretical knowledge, practical skills and abilities.

**Forms of current control** are: *in the dream survey* (frontal, individual, combined), interview; practical verification of professional skills (conducted based on the results of practical work at the end of the class); test control ("open" and "closed" test tasks).

Current control is mandatory. During the evaluation of mastering of each topic from all disciplines of the curriculum for the current educational activity, the student is given grades on a 4-point (traditional scale) taking into account the approved evaluation criteria for the discipline. All types of work provided by the curriculum are taken into account. The student must receive a grade in each topic. The teacher conducts a survey of each student in the group at each lesson and assigns a grade in the journal of attendance and student success according to the traditional scale ("5", "4", "3", "2").

When evaluating the student's current educational activity, 20% of the grade is the student's independent work, which takes into account the knowledge of the topic of independent study and the performance of work in the notebook.

The final (summary) control of the sections is carried out at the end of the section in the form of a written test, which includes test tasks from the "Step-1" bank, theoretical questions and control of practical skills (solving situational problems, defining and describing macro- and micropreparations, etc.) .

Such methods of control as oral, written and test are used, which should contribute to increasing the motivation of students-future specialists for educational and cognitive activities. According to the specifics of professional training, preference is given to test and written control. In the case of final control, preference is given to written or test control.

### **The form of final control of study success .**

The final control of the discipline is carried out on the basis of theoretical control knowledge, practical skills and abilities.

**Assessment** is a form of final control, which consists in assessing the student's learning of the learning material based solely on the results of his performance of certain types of work in practical, seminar or laboratory classes. Semester assessment of subjects is carried out after the end of its study, before the beginning of the examination session.

**An exam (differential assessment)** is a form of final control of a student's assimilation of theoretical and practical material from an educational discipline.

### **Scheme of calculation and distribution of points received by students**

The maximum number of points for a discipline is 200 points. The ratio between the results of the evaluation of the current educational activity and the final control of knowledge is 60% and 40%.

#### **The first semester of studying the discipline ends with a test.**

*The maximum number of points* that a student can score for the current educational activity while studying the discipline is 200 points, the *minimum number of points* - the minimum number of points - is 120 points.

*The calculation of the number of points* is carried out on the basis of the grades received by the student on a 4-point (national) scale during the study of the discipline, by calculating the arithmetic mean, rounded to two decimal places.

The student receives a credit in the last lesson of the discipline based on the results of the current assessment.

**Table 1.**

**Recalculation of the average grade for the current activity into a multi-point scale (for disciplines ending with credit)**

<b>4-point scale</b>	<b>200-point scale</b>	<b>4-point scale</b>	<b>200-point scale</b>	<b>4-point scale</b>	<b>200-point scale</b>	<b>4-point scale</b>	<b>200-point scale</b>
5	200	4.47	179	3.94	158	3.42	137
4.97	199	4.44	178	3.92	157	3.39	136
4.94	198	4.42	177	3.89	156	3.37	135
4.92	197	4.39	176	3.87	155	3.34	134
4.89	196	4.37	175	3.84	154	3.32	133
4.87	195	4.34	174	3.82	153	3.29	132
4.84	194	4.32	173	3.79	152	3.27	131
4.82	193	4.29	172	3.77	151	3.24	130
4.79	192	4.27	171	3.74	150	3.22	129
4.77	191	4.24	170	3.72	149	3.19	128
4.74	190	4.22	169	3.69	148	3.17	127
4.72	189	4.19	168	3.67	147	3.14	126
4.69	188	4.17	167	3.64	146	3.12	125
4.67	187	4.14	166	3.62	145	3.09	124
4.64	186	4.12	165	3.59	144	3.07	123
4.62	185	4.09	164	3.57	143	3.04	122
4.59	184	4.07	163	3.54	142	3.02	121
4.57	183	4.04	162	3.52	141	3	120
4.54	182	4.02	161	3.49	140	< 3	70-119



4.52	181	4.00	160	3.47	139	(refolding)
4.49	180	3.97	159	3.44	138	

Only those students who do not have academic debt and whose average score for the current academic activity in the academic discipline is at least 3.00 are admitted to the credit.

The average grade for the current activity is converted into points on a 200-point scale, according to the conversion table (Table 1).

The learning result is also evaluated on a two-point scale (passed/failed).

**Table 2**

**The scale of transferring points to the national system**

<b>According to the national system</b>	<b>On a 200-point scale</b>
counted	from 120 to 200 points
not counted	less than 119 points

Students' independent work, which is provided for by the topic of the lesson along with classroom work, is evaluated during the current control of the topic in the corresponding lesson.

**The second semester (the last semester of studying the discipline)** ends with a final control in the form of an exam.

Only those students who do not have academic debt (all missed classes have been completed) and whose average score for the current educational activity in the academic discipline is at least "3" are admitted to the exam.

***The maximum number of points*** that a student can score for the current educational activity for admission to the exam is 120 points and is defined as the sum of the arithmetic average of all grades received in the semester.

***The minimum number of points*** that a student must score for the current educational activity for admission to the exam is 72 points. Recalculation of the average grade for the current academic performance (on a 120-point scale) in the table. 3.

**Table 3.**

**Recalculation of the average grade for the current academic performance in a multi-point scale for disciplines ending with an exam**

<b>4-point scale</b>	<b>200-point scale</b>	<b>4-point scale</b>	<b>200-point scale</b>	<b>4-point scale</b>	<b>200-point scale</b>
5	120	4.29	103	3.58	86
4.96	119	4.25	102	3.54	85
4.92	118	4.21	101	3.50	84
4.87	117	4.17	100	3.46	83
4.83	116	4.12	99	3.42	82
4.79	115	4.08	98	3.37	81
4.75	114	4.04	97	3.33	80
4.71	113	4.00	96	3.29	79
4.67	112	3.96	95	3.25	78
4.62	111	3.92	94	3.21	77
4.58	110	3.87	93	3.17	76

4.54	109	3.83	92	3.12	75
4.50	108	3.79	91	3.08	74
4.46	107	3.75	90	3.04	73
4.42	106	3.71	89	3	72
4.37	105	3.67	88	Less than 3	Not enough
4.33	104	3.62	87		

The maximum number of points that a student can score when taking the exam is 80 (the minimum number is at least 50).

Discipline assessment is defined comprehensively as the sum of points for the current educational activity and points for the exam.

From the allocated 120 points for the current educational activity, 4 to 12 additional points are allocated for the assessment of individual independent work of higher education applicants, according to the work curriculum. Encouragement points are added to the final grade for the discipline at the end of its study.

Points with disciplines for students, which successfully completed the program are converted into the national scale and ECTS system (tables 4, 5).

Table 4.

Discipline points	Evaluation on a 4-point scale
From 180 to 200 points	5
From 150 to 179 points	4
From 149 points to the minimum number of points that the student must score	3
Below the minimum number of points that the student must score	2

Table 5

**Scale assessment: national and ECTS**

Sum points	Evaluation of ECTS	Evaluation on a national scale	
		for an exam, a diploma	for credit
180-200	AND	perfectly	counted
160-179	IN	Fine	
150-159	WITH	Satisfactorily	
130-149	D		
120-129	E		
50-119	FX	unsatisfactory with the possibility of refolding	not included with the possibility of refolding
0-49	F	unsatisfactory with mandatory repeated study of the discipline	not enrolled with mandatory re-study disciplines

**9. Methodical support**

1. Working curriculum of the discipline;
2. Plans of lectures, practical classes and independent work of students;
3. Multimedia, video and sound reproduction, projection equipment (video cameras,

projectors , screens, smartboards , etc.);

4. Methodical instructions for practical classes for students;
5. Methodical materials that ensure independent work of students;
6. Test and control tasks for practical classes;
7. List of exam questions

## **10.Recommended literature**

### **Basic literature**

1. Physiology: Textbook for students . higher \_ honey. teach \_ closed / Under the editorship of V.G. Shevchuk 4th type – Vinnytsia: Nova kniga, 2018. – 448 p. ISBN978-966-382-604-2
2. Physiology. Short course. / Under the editorship Moroz V.M., Yoltukhivskiy M.V. 2nd edition – Vinnytsia: Nova kniga, 2019. – 392 p.
3. Physiology: educational and methodological guide for practical classes and independent work / Ed. M. R. Grzehotskyi – Vinnytsia : New Book, 2019. – 464 p.

### **Supporting literature :**

1. Methodical instructions for independent work from the course "Physiology" for students of the 2nd year of specialties 221 "Dentistry", 222 "Medicine", 228 "Pediatrics" full-time study. – Sumy: Sumy State University , 2020. – 330 p.
2. Ataman O.V., Garbuzova V.Yu. General physiology: introduction to physiology, physiology of excitatory structures. - Sumy: Sumy State University , 2009. - 167 p.
3. Garbuzova V.Yu. "Blood physiology" (educational manual). - Sumy: Publishing House of Sumy State University , 2007, 145 p.
4. Filimonov V. I. Human physiology in questions and answers: manual / V. I. Filimonov . – Vinnytsia: Nova kniga, 2010. – 456 p.
5. Atlas of physiology human \_ Schemes . Tables . Drawings / Ed . L. Maloshtan . - Burun and K, 2014. – 416 p.
6. Central nervous system and organs feelings / Ed . O Kalmin . - Phoenix , 2016. - 288 p.
7. USMLE Step 1 Lecture Notes 2018: 7-Book Set Physiology - Kaplan Medical 2018: P 3-425.

### **Informational resource**

[https:// www.netterimages.com/](https://www.netterimages.com/) [https://](https://www.youtube.com/channel/UC0fW0JbGMFvqYOY3V6p-KRg)

[www.youtube.com/channel/UC0fW0JbGMFvqYOY3V6p-KRg](https://www.youtube.com/channel/UC0fW0JbGMFvqYOY3V6p-KRg)

<http://meduniver.com/Medical/Physiology/>

[https:// www.amazon.com/atlas-human-anatomy-interactive-ancillaries/dp/145570](https://www.amazon.com/atlas-human-anatomy-interactive-ancillaries/dp/145570)

<http://www.innerbody.com/htm/body.html>

<http://www.healthline.com/human-body-maps/male>

[https:// www .wiley.com/en-ba/Tortora's+Principles+of+Anatomy+and+Physiology](https://www.wiley.com/en-ba/Tortora's+Principles+of+Anatomy+and+Physiology)