Ministry of Health of Ukraine
Poltava State Medical University

Physiology Department

AGREED
Guarantor of educational and professional program "Medicine"

_____ Ihor SKRYPNYK

"_____" _____ 2023

APPROVED
Chairman of the Academic Council of the Faculty of Dentistry

_____ Alla SIDOROVA

Minutes from _____2023 №__

PHYSIOLOGY

SYLLABUS

level of higher education	the second (master's) level of higher education
branch of knowledge	22 "Health care"
specialty	" Medicine "
educational qualification	master of medicine
professional qualification	doctor
form of education	Day and for a course with a reduced period of study
course and semester of study of the discipline	II course (III, IV semester)

APPROVED
at a meeting of the Department of Physiology

Head Department ____Ihor MISHCHENKO

Minutes from _____ №___

Poltava - 2023 year

INFORMATION ABOUT TEACHERS WHO TEACH THE DISCIPLINE

Teachers' last name, first name, patronymic, scientific degree, academic title	ZaporozhetsT.M., MD, professor t.zaporozhets@pdmu.edu.ua SukhomlynT.A.PhD associate professor t.sukhomlyn@pdmu.edu.ua Sukhomlyn A.A. PhD a.sukhomlyn@pdmu.edu.ua Tkachenko O.V. PhD o.tkachenko@pdmu.edu.ua
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MAIN CHARACTERISTICS OF THE COURSE

The scope of the discipline

Number of credits / hours – 9/270,

Lectures (hours) - 36

Practical classes (hours) - 108

Independent work (hours). - 126

Type of control – Final semester attestation

Course policy

The higher education applicants must comply with the requirements of the curriculum within the timeframe specified in the schedule of the educational process and the individual curriculum; adhere to academic integrity, and achieve the learning outcomes determined for the relevant level of higher education; come to classes on time, in accordance with the schedule of classes; rework all missed classes; comply with the requirements for the appearance of persons studying at the university. During the educational process higher education applicants must adhere to the business style of clothing of a professional, clothing should be clean and ironed. During their stay at the department, higher education applicants must comply with the requirements for appearance (so - called dress code) of persons working and studying at the university, approved by the decision of the Rector's Office from 29.08.2014 to maintain order in classrooms, carefully and neatly treat property university (furniture, equipment, textbooks, books, etc.); to prevent illegal actions, immoral acts, both at the university and abroad.

When organizing the educational process in PSMU, teachers and higher education applicants act in accordance with:

Regulations on the organization of the educational process in PSMU;

Regulations on the academic integrity of higher education seekers and PSMU staff.

Guidance for the higher education applicants PSMU, of the organization and methodology of evaluation of educational activity higher education applicants in PSMU, regulations on the organization of independent work of higher education applicants in PSMU, Regulations on working missed classes and unsatisfactory ratings of higher education applicants in PSMU, Regulation on the procedure for forming individual educational trajectories by higher education applicants in PSMU, Regulations on the procedure for re-enrollment of academic disciplines and determination of academic difference, Regulations on appealing the results of final control of knowledge of higher education applicants, Regulations on rating of higher education applicants, Regulations on material incentives higher education applicants in PSMU, etc.

All the above documents are posted on the page of the department of scientific and pedagogical work and organization of the educational and scientific process of PSMU.

https://www.pdmu.edu.ua/n-process/viddil-monitoryngu-osvity/informaciyi-materiali-n-process-vimo-ek9k

Description of the discipline (abstract)

Physiology (Greek φυσιολογία - natural science) is the science about life processes, the activity of individual organs and their systems and the whole organism. The main thing in physiology is the experimental method of research, which was established by the English scientist Francis Bacon.

The subject of study of the discipline of physiology are the functions of a living organism, their relationships, regulation and adaptation to the environment, the origin and development in the process of evolution and individual development of the individual.

Prerequisites and postrequisites of the discipline (interdisciplinary links)

Prerequisites of the discipline. The study of physiology is based on the knowledge gained by higher education applicants in the study of disciplines: Medical Biology, Human Anatomy, Foreign Language, Histology, Cytology and Embryology, Ukrainian (Professional), Latin and Medical Terminology, Medical and Biological Physics, History of Ukraine and Ukrainian culture, Philosophy, Human Anatomy, History of Medicine, Biological and bioorganic chemistry, Life safety, Basics of bioethics and biosafety.

Postrequisites of the discipline.

To explore the options listed below disciplines required knowledge and skills, acquired after completion of studying physiology: pathological physiology, physiotherapy and sport medicine, pathological anatomy, histology, pharmacology, human anatomy, biology, ophthalmology, otolaryngology, internal medicine, psychiatry, medical psychology, narcology, pediatrics, obstetrics, nervous care with neurosurgery.

The purpose and objectives of the discipline:

- the purpose of studying the discipline is to know the function of various cells, tissues, organs and systems in general in order to use the acquired knowledge in the study of subsequent medical disciplines, and in future professional activities. Establishes an understanding of the concept of health, healthy lifestyle and prevention of dysfunction in the process of life.
- The main tasks of studying the discipline are a systematic approach to the study of the essence of physiological processes, functions of individual organs, systems and the whole organism. Study of nervous and endocrine regulation of the body, its organs and systems. To reveal the physiological mechanisms of interaction of organs and their systems. To study the mechanisms of pharmacological correction of physiological processes of the organism. To form in higher education applicants practical skills of definition and estimation of functional features of an organism. Expand understanding of the role of studying human physiology for other medical disciplines.

Competences and learning outcomes in accordance with the educational and professional program, the formation of which is facilitated by the discipline (integral, general, special)

Integral competence: the ability to solve complex problems and problems in the field of health care in the specialty " Medicine " in professional activities or in the learning process, which involves research and / or innovation and is characterized by uncertainty of conditions and requirements.

General:

1. Ability to abstract thinking, analysis and synthesis, the ability to learn and master modern knowledge.
2. Ability to apply knowledge in practical situations.
3. Knowledge and understanding of the subject area and understanding of professional activity.
4. Ability to adapt and act in a new situation.
5. Ability to communicate in the state language both orally and in writing; ability to communicate in a foreign language. Ability to use international Greco-Latin terms, abbreviations and clichés in professional oral and written speech.

Special:

1. Ability to establish a preliminary and clinical diagnosis of the disease.
2. Ability to determine the required mode of work and rest in the treatment of diseases
3. Ability to determine the principles and nature of disease treatment.
4. Ability to diagnose emergencies.
5. Skills to perform medical manipulations.
6. Ability to determine the tactics of physiological pregnancy, physiological childbirth and the postpartum period. Counseling skills on family planning and contraception selection.
7. Ability to assess the impact of the environment, socio-economic and biological determinants on the health of the individual, family, population

Program learning outcomes:

1. Know the structure and functions of individual organs and systems and the human body as a whole in the norm, with the development of pathological processes, diseases; be able to use the acquired knowledge in further training and in the practice of the doctor.
2. Establish a preliminary and clinical diagnosis of the disease (list 2) on the basis of leading clinical symptoms or syndromes (list 1) by making an informed decision and logical analysis, using the most probable or syndrome diagnosis, laboratory and instrumental examination of the patient, conclusions of differential diagnosis, knowledge about a person, his organs and systems, adhering to the relevant ethical and legal norms.
3. Determine the necessary mode of work and rest in the treatment of the disease (according to list 2) in a health care facility, at home of the patient and at the stages of medical evacuation, including in the field, on the basis of a preliminary clinical diagnosis, using knowledge about the person, his organs and systems, adhering to the relevant ethical and legal norms, by making an informed decision according to existing algorithms and standard schemes.
4. Determine the nature of treatment of the disease (conservative, operative)

and its principles (according to list 2) in a health care facility, at the patient's home and at the stages of medical evacuation, including in the field on the basis of a preliminary clinical diagnosis, using knowledge about the person, his organs and systems, adhering to the relevant ethical and legal norms, by making an informed decision according to existing algorithms and standard schemes.

5. Carry out diagnostics of emergencies and establish a diagnosis (according to list 3) by making an informed decision and assessing a person's condition under any circumstances (at home, on the street, in a health care facility), including in emergency situations, in field conditions, in conditions of lack of information and limited time, using standard methods of physical examination and possible anamnesis, knowledge about a person, his organs and systems, adhering to the relevant ethical and legal norms.

6. Perform medical manipulations (according to list 5) in a health care facility, at home or at work on the basis of a previous clinical diagnosis and / or indicators of the patient's condition, using knowledge about the person, his organs and systems, adhering to relevant ethical and legal norms, making an informed decision and using standard techniques.

7. Assess the impact of the environment, socio-economic and biological determinants on the health of the individual, family, population. Carry out analysis of morbidity of the population, identifying risk groups, risk areas, time and risk factors in the health care institution, using statistical and laboratory methods.

8. Adhere to the requirements of ethics, bioethics and deontology in their professional activities.

Learning outcomes for the discipline:

upon completion of the study of the discipline, applicants for higher education must

know:

- Physiology of excitable tissues.
- Physiology of nervous regulation of body functions
- The role of the CNS in the regulation of motor functions
- Physiology of sensory systems
- Physiological bases of behavior, higher nervous activity
- The role of the autonomic nervous system in the regulation of visceral functions
- The role of endocrine glands in the regulation of visceral functions.
- Physiological bases of labor activity and sports
- Physiology of the blood system
- Physiology of the circulatory system
- Physiology of the respiratory system
- Physiology of energy metabolism and thermoregulation
- Physiology of the digestive system
- Physiology of the excretory system

be able:

- To draw a conclusion about the state of physiological functions of the organism, its systems and organs
- Analyze the age characteristics of body functions and their regulation
- Analyze the regulated parameters and draw conclusions about the

mechanisms of nervous and humoral regulation of physiological functions of the organism and its systems

- Analyze the state of human health under different conditions on the basis of physiological criteria
- Interpret the mechanisms and patterns of functioning of excitable structures of the body
- Analyze the state of sensory processes in ensuring human life
- Explain the physiological basis of methods for studying the functions of the body
- Explain the mechanisms of integrative activity of the organism

Thematic plan of lectures (by modules) with the indication of the basic questions considered at lectures

№ p / p	Name topics	Number hours
1.	**Introduction to the course of physiology. Excitable tissues. Biopotentials . Muscle physiology.** 1. Physiology as a science. The concept of functions. Methods of physiological research. 2. Resting membrane potential, mechanisms of origin, its parameters, physiological role. 3. Action potential, mechanisms of origin, its parameters, physiological role. 4. Excitability. Critical level of depolarization, threshold of cell membrane depolarization. 5. Changes in cell excitability with the development of a single action potential. 6. Values of parameters of electrical stimuli for excitation. 7. Coupling of excitation and contraction. Mechanisms of contraction and relaxation of skeletal muscles. 8. Types of muscle contractions: single and tetanic; isotonic and isometric.	2
2.	**Physiology of receptors, nerve fibers, synapses** 1. Reflex arc. Physiology of receptors. 2. Mechanisms of conduction of excitation by nerve fibers. 3. Patterns of excitation by nerve fibers. 4. Mechanisms of excitation transmission through neuromuscular synapse .	2
3.	**Excitation and inhibition in the CNS. Principles of coordination of reflex activity.** 1. Excitation processes in the CNS. 2. Inhibition processes in the CNS. 3. Mechanisms of coordination of reflex activity.	2
4.	**The role of different levels of the CNS in the regulation of motor functions.** 1. The role of the spinal cord in the regulation of motor functions of the body. 2. Conductive function of the spinal cord. 3. Physiological bases of pain and anesthesia. 4. Somato-sensory system 5. The role of the hindbrain in the regulation of motor and sensory functions. 6. The role of the midbrain in the regulation of motor and sensory functions. 7. The role of the cerebellum, diencephalon, subcortical nuclei, cortex in the regulation of motor functions. 8. The role of the cortex in the formation of systemic activity of the organism.	2
5.	**Physiology of the autonomic nervous system, its role in the regulation of visceral functions.** 1. Structural and functional organization of the autonomic nervous system, its role in the regulation of visceral functions. ***2.*** Autonomous reflexes, their practical use in the clinic.	2

6.	**Humoral regulation of visceral functions, the role of hormones in regulation.** 1. Humoral regulation, its factors, mechanisms of action of hormones on target cells, regulation of hormone secretion. Hypothalamic-pituitary system. 2. The role of hormones in the regulation of mental, physical development and linear growth of the body, in the regulation of adaptation of the organism, in the regulation of homeostasis. (hormones of the thyroid gland, thyroid gland, pancreas). 3. The role of hormones in the regulation of adaptation of the organism. Hormones of the cortex and medulla of the adrenal glands ***4.*** The role of hormones in the regulation of sexual functions.	**2**
7.	**General characteristics of the blood system. Blood as a means of transport and the internal environment of the body.** 1. The concept of the blood system. 2. Basic blood functions. 3. The composition and volume of blood in humans. 4. Hematocrit index. 5. Basic physiological constants of blood, mechanisms of their regulation. 6. Plasma, its composition, the role of plasma proteins. 7. Osmotic and oncotic pressures. 8. Regulation of osmotic pressure constancy. 9. Acid-base state of blood, the role of buffer systems in the regulation of its stability.	**2**

8.	**Physiology of erythrocytes. Blood groups.** 1. Erythrocytes, structure, number, functions. 2. Hemoglobin, its structure, properties, types, compounds. 3. The amount of hemoglobin. 4. Criteria for saturation of erythrocytes with hemoglobin: average concentration, color index. 5. Hemolysis, its types. 6. Erythrocytes sedimentation rate (ESR), the factors that affect it. 7. The concept of erythron as a physiological system, regulation of the number of erythrocytes in the blood. 8. Blood groups: ABO, CDE systems, others. 9. Physiological basis of blood transfusion. Blood substitutes.	**2**
9.	**Physiology of leukocytes.** 1. Leukocytes, their number, types. 2. The concept of leukocytosis and leukopenia. 3. Leukocyte formula. 4. Functions of different types of leukocytes. 5. Regulation of the number of leukocytes. 6. The concept of immunity, its types.	**2**
10.	**Platelet physiology. Vascular and platelet hemostasis. Coagulation hemostasis. DIC syndrome . Anticoagulants and fibrinolysis. Regulation of blood clotting.** 1. Platelets, vascular platelet hemostasis. 2. Blood clotting study .. 3. Fibrinolysis and anticoagulants. 4. Regulation of blood clotting and fibrinolysis. 5. DIC syndrome . 6. Differential coagulogram . 7. General clinical blood test	**2**
11.	**Circulatory system. Physiological properties of the heart muscle. ECG.** 1. The structure of the heart, its functions. 2. Heart muscle, its structure, functions 3. Physiological properties of the myocardium and their features. 4. Automaticity of the heart. 5. The action potential of atypical cardiomyocytes of the driver of the heart rhythm – sinoatrial node. 6. Heart conductive system, its functional features, the rate of excitation of the heart structures. 7. The action potential of typical cardiomyocytes . 8. Periods of refractoriness . 9. Mechanisms of cardiomyocyte contraction and relaxation .	**2**

12.	**Phases of cardiac activity, heart tones.** 1. Cardiac cycle, its phase structure. 2. Blood pressure in the heart cavities and the operation of the valvular apparatus during cardiac activity. 3. Systolic and cardiac output, cardiac index. 4. The work of the heart. 5. Physiological bases of research methods: electrocardiography, phonocardiography, echocardiography, others.	**2**
13.	**The role of blood vessels in blood circulation.** 1. Blood pressure: arterial (systolic, diastolic , pulse, average), capillary, venous. 2. Arterial pulse, its main parameters. 3. Systemic circulation. 4. Basic laws of hemodynamics. 5. Functional classification of blood vessels. Physiological characteristics of vessels of compression, resistance (resistive). 6. Microcirculation . 7. Physiological characteristics of capacitive vessels.	**2**

14.	**Physiology of the respiratory system.** 1. External respiration. 2. Respiratory cycle. 3. Pulmonary ventilation. 4. Gas exchange. 5. Transportation of blood gases, yu. 6. Regulation of respiration.	**4**
15.	**Energy metabolism. Thermoregulation.** 1. General concepts of metabolism in the body. 2. Metabolism between the body and the environment 3. Energy metabolism. 4. Caloric ratio of one liter of oxygen. 5. Respiratory rate. 6. The basic exchange, size, conditions of its research. 7. Specific-dynamic action of nutrients. 8. Work exchange. 9. Energy costs of the body in different types of work. 10. Thermoregulation.	**2**
16.	**Digestion in the oral cavity. The role of taste and olfactory sensory systems. Digestion in the stomach. Regulation of secretory and motor function of the stomach.** 1. digestion in the oral cavity. 2. The role of taste and olfactory sensory systems. 3. Secretory activity of gastric glands. 4. Composition and properties of gastric juice. 5. Mechanisms of secretion of hydrochloric acid, enzymes, mucus and their regulation. 6. Nervous and humoral regulation of gastric secretion, phases of secretion regulation: cephalic, gastric, intestinal. 7. Adaptive changes in gastric secretion. 8. Motor function of the stomach, its regulation.	**2**

17.	**Digestion in the duodenum, the role of the pancreas and liver in digestion, regulation of their secretory and motor functions. Digestion in the lumen of the intestines. Regulation of secretory and motor functions of the intestines. Absorption.** 1. digestion in the duodenum. 2. Exocrine activity of the pancreas. 3. The amount, composition and properties of pancreatic juice, its role in digestion. 4. Nervous and humoral regulation of pancreatic secretion. 5. Phases of secretion regulation: cephalic, gastric, intestinal. 6. The role of the liver in digestion. 7. The formation of bile, its composition and properties. 8. Hepatic and gallbladder bile. 9. Involvement of bile in digestion. 10. Regulation of bile formation and its secretion into the duodenum. 11. Intestinal secretion, composition and properties of intestinal juice, its role in digestion. 12. Regulation of intestinal secretion. 13. Cavity and membrane hydrolysis of nutrients. 14. Motor activity of the small intestine, its role in digestion. 15. Types of motility, its regulation. 16. The role of the metasympathetic system in the regulation of secretory and motor functions of the intestine. 17. Digestion in the colon. 18. The role of intestinal microflora. 19. Motility of the colon, its regulation. 20. Act of defecation. 21. Absorption processes. 22. Physiological bases of hunger and satiety	**4**

18.	**Physiology of the excretory system.** 1. The role of the kidneys in the processes of excretion. 2. Mechanisms of urination and urination. 3. Regulation of urination and urination. 4. Clinical analysis of urine. 5. Involvement of the kidneys in maintaining homeostasis.	**2**
	Together	**36**

Thematic plan of practical classes by modules and content modules with indication of the main issues considered in the practical lesson

№ p / p	**Name topics**	**Number hours**

1	***Topic 1. Subject and tasks of physiology. Methods of physiological research . Excitability . Excitation. Laws of irritation.*** Physiology is a science that studies the objective laws of the functions of the human body and its structures (systems, organs, tissues, cells) in their unity and interaction of the organism with the external environment. Physiology as a scientific basis of medicine about the functions of the body, ways to maintain health and efficiency. The importance of physiology in the training of physicians. Methods of physiological research: observations, experiments, modeling. Levels of structure of a human body and its functions. The unity of the organism and the external environment Physiological characteristics of functions, their parameters. The relationship between structure and function. Age and gender features. Functions of cells, tissues, organs, physiological systems of the body. Homeostasis and homeokinesis . Characteristics of the development of physiology. The role of the works of W. Harvey , R. Descartes. Formation and development of physiology in the XIX century (K. Bernard , E. Dubois-Raymond , W. Cannon , K. Ludwig, C. Sherington). The contribution of the works of I.M. Sechenov, I.P. Pavlov, M.E. Vvedensky , O.O. Ukhtomsky , L.A. Orbeli , P.K. Anokhin, P.G. Kostyuk in the development of world physiology. Ukrainian School of Physiology - V.Ya. Danilevsky, V.Yu. Chagovets , D.S. Vorontsov, P.M. Serkov , P.G. Kostyuk , V.I. Skok , M.F. Shuba, G.V. Folbort, W.W. Frolkis .	2

2	***Topic 2. Membrane potentials. Resting membrane potential and action potential. Changes in excitability during action potential.***Irritability, excitability as the basis of tissue response to irritation. Excitation. Modern idea of the structure and function of cell membranes. Transport of ions across membranes. Ion channels of membranes, their types, functions. Membrane ion pumps, their functions. Ionic gradients of the cell - ionic asymmetry. Membrane receptors, their functions. Membrane rest potential (RMP), mechanisms of origin, methods of registration, parameters of RMP. Physiological role of RMP. Action potential (AP), mechanisms of origin, methods of registration, phases of AP, parameters of AP. Physiological role of AP. Changes in cell excitability during AP development. Periods of absolute and relative refractoriness, mechanisms of their origin, physiological significance. Changes in membrane potential under the action of electric current as a stimulus. Local response. The level of critical depolarization. Depolarization threshold as a measure of excitability. The effect of direct current on excitable tissues, its use in clinical practice.	**2**
3	***Topic 3. Study of the mechanisms of skeletal muscle contraction. Electromyography.*** The principle of the method, types and practical application. Quantitative and qualitative analysis. Muscle physiology. Mechanisms of skeletal muscle contraction and relaxation. Mechanisms of coupling of excitation and contraction in muscle fibers. Functions and properties of skeletal muscles. Types of muscle fibers. Types of muscle contraction depending on the frequency of irritation: single, tetanic. Types of muscle contraction depending on changes in their length and tension: isometric, isotonic. The relationship between the length of a muscle fiber and its tension. The relationship between the rate of muscle contraction and their load. Properties of muscles in the body. Motor units. Electromyography. Muscle strength and function. Dynamometry. Energy of muscle contraction.	**2**
4	***Topic 4. Comparative characteristics of skeletal and smooth muscle.*** Physiology of smooth muscles. Mechanisms of smooth muscle contraction and relaxation. Mechanisms of combination of excitation and contraction in smooth muscle fibers. Functions and properties of smooth muscles. Types of smooth muscle fibers. Energy of muscle contraction. Features of excitation, contraction and comparison with skeletal.	**2**

5	***Topic 5. Research of a reflex arc. Physiology of receptors.*** Biological regulation, its types, contours of biological regulation, adjustable parameters, the role of feedback in the contour of biological regulation. Nervous regulation of functions. Neuron as a structural and functional unit of the CNS. Types of neurons, their functions. Neural circuits. Reflex, reflex arc, functions of its links, mechanisms of coding and transmission of information by links of reflex arc. The role of receptors. Nerve centers and their physiological properties Principles of reflex coordination. Types of reflexes, their physiological significance.	**2**
6	***Topic 6. Research of conduction of excitation by nerve fibers.*** Physiological properties of nerve fibers. Mechanisms of nerve impulse conduction by myelinated and unmyelinated nerve fibers. Patterns of excitation. The rate of excitation, the factors on which it depends. Characteristics of nerve fibers of type A, B, C.	**2**
7	***Topic 7. Research of conduction of excitation through synapses .*** CNS synapses, their structure, mechanisms of information transfer. Neurotransmitters (acetylcholine, norepinephrine, dopamine, glycine, GABA, glutamate, serotonin, nitric oxide, others) and neuromodulators (neuropeptides, neurosteroids, others). Excitatory synapses , their neurotransmitters, cytoreceptors, development of excitatory postsynaptic potential (EPSP), its parameters, physiological role. Excitation transmission blockers. Neuromuscular junction, its structure, functions. Mechanisms of chemical transmission of excitation through neuromuscular junction. End plate potential (EPP). Physiological mechanisms of neuromuscular transmission blockade.	**2**

8	***Topic 8. Research of excitation processes in the CNS. Research of processes and inhibition in the CNS.*** Processes of excitation and inhibition in the CNS. Inhibitory synapses, their neurotransmitters. Postsynaptic inhibition, development of inhibitory postsynaptic potential (IPSP). Presynaptic inhibition, mechanisms of development. Central inhibition (IM Sechenov). Summation processes in central synapses: spatial summation, temporal summation. Summation of excitation and inhibition by CNS neurons.	**2**
9	***Topic 9. Research of mechanisms of coordination of reflex activity.*** The concept of "nerve center". Its properties. Mechanisms of coordination of reflex activity (convergence, divergence, types of inhibition of motoneurons - reverse, reciprocal). The principle of dominance and the common final path.	**2**
10	***Topic 10. Research of the role of the spinal cord in the regulation of motor functions of the body.*** Motor systems of the spinal cord, their organization and coordination mechanisms (convergence, divergence, types of inhibition of motoneurons - reverse, reciprocal). Physiological characteristics of proprioceptors . Muscle spindles or stretch receptors, their structure and function. Stretching reflexes (myotatic, their reflex arcs, gamma-loop functions. Activation of alpha and gamma motoneurons by upper motor centers. The role of stretching reflexes in the regulation of tone (tonic myotatic reflexes) and muscle length (phase myotatic reflexes). Clinical significance of the study of myotatic reflexes. Golgi tendon receptors, their functions, reflexes from tendon receptors, their reflex arcs, physiological significance. Flexory and extensory spinal reflexes. Functional capabilities of the isolated spinal cord. Spinal cord cross section and spinal shock.	**2**
11	***Topic 11. Research of conduction function and spinal cord. Physiological bases of pain and anesthesia. Research of somato- sensory system.*** Analysis of sensory information by the spinal cord. Ascending and descending pathways of the spinal cord. Conductive function of the spinal cord, its role in the regulation of motor functions.	**2**
12	***Topic 12. Research of the role of the hindbrain in the regulation of motor and sensory functions.*** Descending motor pathways, their role in regulating the activity of alpha and gamma motoneurons. The role of the hindbrain in the provided antigravital posture (vestibular nuclei and reticular formation), mechanisms of decerebrative rigidity. Tonic labyrinthine reflexes. Vestibular receptors of the saccule and utricle, their role in the regulation of tone and posture. Tonic cervical reflexes.	**2**
13	***Topic 13. Research of the role of the midbrain in the regulation of motor and sensory functions.*** Motor reflexes of the midbrain: static and stato-kinetic . Righting reflexes (labyrinthine, cervical). Head rotations and receptors of semicircular canals, their physiological role in maintaining the posture of balance during movement with acceleration. Vestibular mechanisms of stabilization of eyeballs. The role of the midbrain in the regulation of stereotyped involuntary movements. Approximate reflexes. The role of reticular formation in the regulation of motor functions. Descending and ascending influences of the reticular formation of the brainstem, the work of Megun and Moruchi .	**2**

14	***Topic 14. Research of the role of the cerebellum, diencephalon, basal ganglia, cortex in the regulation of motor functions.*** ***The role of the cerebellum in the regulation of motor functions.*** Functional and 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, initiating and controlling movements. Cerebellum and learning. Consequences of removal or damage to the cerebellum that occur in humans, their physiological mechanisms. ***The role of the thalamus in the regulation of motor functions*** Functional characteristics of thalamic nuclei (specific: switching, associative, motor, nonspecific) in the regulation of motor functions. ***The role of basal ganglia in the regulation of motor functions.*** Functional organization and communication basal nuclei (caudate nucleus, putamen and pale globe). The role of basal ganglia 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, other structures. Neurotransmitters in the system of basal ganglia, their physiological role. Cycles of putamen and caudal body. Clinical manifestations of damaged basal ganglia, their physiological mechanisms. ***The role of motor areas of the cortex in the regulation of motor functions.*** Primary motor zone of the cortex (field 4), its functional organization and role in the regulation of motor functions. Premotor and additional motor areas of the cortex, their organization and role in the regulation of motor functions. Afferent connections of the motor cortex. Descending conductive pathways: corticonuclear, corticospinal - lateral, ventral, their role in the regulation of the functions of the muscles of the axial skeleton, proximal and distal extremities. Human locomotions, their regulation. Motion programming. Functional structure of arbitrary movements. Age-related changes in motor functions. ***The role of the cerebral cortex in the formation of systemic activity of the organism .*** Physiological anatomy of the cerebral cortex. Modern ideas about the localization of functions in the cortex and its organization. Functional connections of the cerebral cortex with the structures of the CNS. Functions of separate fields of bark (associative, sensory, motor). The role of the cortex in the formation of operations at the system - those body functions Electrophysiological methods cortex, electroencephalography (EEG), evoked potentials registration, impulse activity of neurons. Maintaining the activity of the cerebral cortex. Ascending activating effects of the reticular formation of the brain stem. Neuro-hormonal control of brain activity (noradrenergic, dopaminergic, serotonergic effects). Neuro-hormonal systems of the brain. ***The role of the limbic system in the formation of systemic activity of the organism.*** The limbic system, its organization, functions, the leading role of the hypothalamus. Features of the functions of neurons of the hypothalamus: neuroreception, neurosecretion. The role of the hypothalamus in the regulation of visceral functions, the integration of somatic, autonomic and endocrine mechanisms in the regulation of homeostasis, the formation of motivations, emotions, nonspecific adaptation of the organism, biological rhythms. Specific functions of other structures of the limbic system - hippocampus , tonsils, limbic cortex.	**2**
15	***Topic 15. Research of the role of the cortex in the formation of systemic activity of the organism. Electroencephalography .*** Electrical activity of the brain, its graphic registration - electroencephalography (EEG). Application of EEG. Types of waves. Sleep, mechanisms of sleep, its types, phases and biological role.	**2**

16	***Topic 16. Structural and functional organization of the autonomic nervous system, its role in the regulation of visceral functions.*** Structural and functional organization of the autonomic nervous system. Sympathetic, parasympathetic and metasympathetic divisions, their role in the regulation of visceral functions. Central regulation of visceral functions. Integrative centers of regulation of visceral functions. The role of the brainstem. Hypothalamus, its afferent and efferent connections. Functions of the hypothalamus in the regulation of visceral functions	**2**
17	***Topic 17. Autonomous reflexes, their practical use in the clinic.*** Autonomous reflexes, features of the structure of the efferent link of their reflex arcs. Autonomous ganglia, their functions. Mechanisms of excitation transmission in ganglionic and neuro-organ synapses of sympathetic and parasympathetic systems. Neurotransmitters of autonomic nervous system. Types of cytoreceptors (cholinergic, adrenergic, purinergic, serotonergic and others). Excitation transmission blockers at synapses. Influences of sympathetic, parasympathetic and metasympathetic departments on organ functions.	**2**
18	***Topic 18. Humoral regulation, its factors, mechanisms of action of hormones on target cells, regulation of hormone secretion. Hypothalamic-pituitary system.*** Factors of humoral regulation, their characteristics and classification. The contour of humoral regulation, the role of feedback in regulation. Relationship of nervous and humoral regulation. Structural and functional organization of the endocrine system. Endocrine glands, endocrine cells, their hormones and significance. The main mechanisms of action of hormones. Membrane and intracellular receptors, G-proteins, secondary mediators (cAMP , cGMP , Ca^{2+}, NO, etc.), their role. Regulation of hormone secretion. Hypothalamic-pituitary system. Functional connection of the hypothalamus with the pituitary gland. Neurosecretes of the hypothalamus. The role of liberins and statins .	**2**
19	***Topic 19. The role of hormones in the regulation of mental, physical development and linear growth of the body, in the regulation of adaptation of the organism, in the regulation of homeostasis. (hormones of the thyroid gland, thyroid gland, pancreas). The role of hormones in the regulation of adaptation of the organism. Hormones of the cortex and medulla of the adrenal glands . The role of hormones in the regulation of sexual functions.*** Adenohypophysis , its hormones, their effects. The role of somatotropin (STG) and somatomedins (insulin- like growth factor I: IGF-I, insulin- like growth factor II: IGF-II) in ensuring growth and development. Contour of regulation of synthesis and secretion of somatotropin . Metabolic effects of somatotropin Contour of regulation of STG secretion, circadian rhythms. Metabolic effects of HGH. Thyroid gland, its hormones (iodothyronines). 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. Contour of regulation of synthesis and secretion of thyroxine (T_4) and triiodothyronine (T_3). The role of other hormones that affect the processes of normal growth (insulin, gonadal steroid hormones , cortisol). Pancreatic hormones (insulin, glucagon , somatostatin) and their effects on metabolism and blood glucose concentration. Contour of hormonal regulation of maintenance of constancy of concentration of glucose in blood. Calcium balance in the body and hormones that regulate calcium and phosphate homeostasis: parathyroid hormone , calcitonin , calcitriol or 1.25 $(OH)_2$ D_3. Influence of other hormones on calcium metabolism (glucocorticoids, somatotropin and IGF-1, thyroid hormones, estrogens, insulin). The role of vasopressin, oxytocin . Hormones of the adrenal medulla (catecholamine), 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	**2**

	of action on target cells. The concept of stress and stressors. Types of adaptation to stress factors. General adaptation syndrome (G. Cellier). The role of the sympathetic-adrenal system in adaptation. The role of hormones of the adrenal cortex (glucocorticoids , mineralocorticoids), pituitary gland, thyroid hormones (thyroxine, triiodothyronine), vago-insular system in ensuring non-specific adaptation of the body to stress factors. Gonads. Sexual differentiation, development and functions of the reproductive system. Puberty. Male reproductive system, its structure and functions. Spermatogenesis. Endocrine function of the testes, regulation of testicular function, the contour of regulation with the participation of the hypothalamic-pituitary 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. Menstrual cycle. Pregnancy. Placental hormones. Lactation. Age features of endocrine gland functions.	
20	***Topic 20. General characteristics of sensory systems. Research of visual and auditory sensory systems.*** The concept of sensor systems or analyzers. The value of sensory systems in cognition of the world. Systemic nature of perception. Structural and functional organization of the sensory system. Receptors: classification, basic properties, excitation mechanisms, functional lability. Regulation of receptor function. The concept of the receptive field and reflexogenic zones. Methods for studying the excitability of receptors. Conducting department of the sensor system. Leading paths: specific and nonspecific channels of information transmission. Participation of structures of the spinal cord, brain stem, thalamus in the conduction and processing of afferent excitations. Thalamus as a collector of afferent pathways. Functional characteristics of specific (relay, associative) and nonspecific thalamic nuclei. 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 different departments of the sensory system. Physiological bases of methods of research of sensory systems. Age-related changes in sensory systems. Structural and functional organization of the somato-sensory system (skin and proprioceptive sensitivities). Physiological basis of pain. Nociception , physiological characteristics and classification of nociceptors (C. Sherrington). Nociceptive or pain system, its structural and functional organization, leading pathways and levels of information processing. Physiological significance of pain. Antinociceptive or analgesic system, its structural and functional organization, opiate and non- opiate mechanisms, physiological role. Physiological bases of anesthesia. Structural and functional organization of the visual sensory system, main and auxiliary structures. Receptor apparatus: rods and cones. Photochemical processes in receptors (rods and cones) 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 the perception of color. The main forms of color perception disorders. Basic visual functions and physiological bases 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, conduction and cortical departments, central analysis of information at different levels. Perception of the position of the head in space and direction of movement.	**2**

21	***Topic 21. Research of processes of formation and inhibition of conditioned reflexes.*** Congenital (unconditionally reflex) forms of behavior. Instincts, their importance for the adaptive activity of the organism. Acquired (conditioned-reflex) forms of behavior, their significance for the adaptive activity of the organism. Regularities of formation and storage of conditioned reflexes (IP Pavlov).	**2**
22	***Theme 22. Research congenital and acquired forms of behavior, attention, learning, memory, motivation and emotion, thought and language, mind and consciousness***. The concept of higher nervous activity, methods of its research. The contribution of I.M. Sechenov, I.P. Pavlov in the development of GNI research. Physiological bases of behavior. Learning and memory, its types, mechanisms. Needs and motivations, their physiological mechanisms, the role in shaping behavior Functional system of behavior. The structure of a holistic behavioral act according to P.K. Anokhin. Emotions, their types, mechanisms of formation, biological role. Theories of emotions. Functions of the new cerebral cortex and higher human nervous activity. Functional asymmetry of the cerebral cortex, the concept of the dominant hemisphere, the functions of the non-dominant hemisphere, the interaction of the hemispheres. Language. Language functions. Physiological bases of its formation. Age aspects of higher nervous activity in humans. Thinking. The role of brain structures in the thinking process. Consciousness.	**2**
23.	***Topic 23. Sleep, its types, phases, physiological role. Research of HNA types.*** The types of higher nervous activity, classification, physiological foundations, research methods. The role of education. Types of nervous system in humans, methods of their study.	**2**
24	***Topic 24. Final computer testing, content module control of module 1-10.*** Consolidation of acquired knowledge and their verification.	**4**
25	***Topic 25. Research of physical and chemical properties of blood.*** The concept of the blood system. Basic blood functions. The composition and volume of blood in humans. Hematocrit index. Basic physiological constants of blood, mechanisms of their regulation. Plasma, its composition, the role of plasma proteins. Osmotic and oncotic pressures. Regulation of osmotic pressure constancy. Acid-base state of blood, the role of buffer systems in the regulation of its stability.	**2**
26	***Topic 26. Study of the erythrocytes count and hemoglobin in the blood.*** Erythrocytes, structure, number, functions. Hemoglobin, its structure, properties, types, compounds. The amount of hemoglobin. Criteria for saturation of erythrocytes with hemoglobin: average concentration, color index. Hemolysis, its types. Erythrocyte sedimentation rate (ESR), the factors that affect it. The concept of erythron as a physiological system, regulation of the number of erythrocytes in the blood.	**2**
27.	***Topic 27. Research of blood typing.*** Blood groups: ABO, CDE systems, others. Methods of determining blood groups. Physiological basis of blood transfusion. Blood substitutes.	**2**
28	***Topic 28. Study of the leukocyte count, leukocyte formula.*** Leukocytes, their number, types. The concept of leukocytosis and leukopenia. Leukocyte formula. Functions of different types of leukocytes. Regulation of the number of leukocytes. The concept of immunity, its types.	**2**

29	***Topic 29. Study of platelets, vascular platelet hemostasis.*** Platelets, their number, functions. Hemostasis, its types. Vascular and platelet hemostasis, its role.	**2**
30	***Topic 30. Research of blood clotting.*** Coagulation hemostasis, its phases, mechanisms, significance. Modern ideas about the main factor, participating in coagulation hemostasis - coagulants.	**2**
31	***Topic 31. Fibrinolysis and anticoagulants. Regulation of blood clotting and fibrinolysis. DIC syndrome .*** Mechanisms for maintaining the liquid state of the blood. Anticoagulants, their types, mechanisms of action, significance. Plasmin and fibrinolysis, its mechanisms, significance. The role of the vascular wall in the regulation of hemostasis and fibrinolysis. Regulation of blood clotting. The concept of DIC syndrome .	**2**
32	***Topic 32. Complete blood count*** Indicators of clinical blood analysis and their importance for the differential diagnosis of pathological processes. Hematopoiesis and its regulation. Age-related changes in the blood system. Extravascular fluids and their role in ensuring the vital activity of cells.	**2**
33	***Topic 33. Practical skills and solutions binding situational problems with thematic module 11.*** Assess the state of the blood system, its functions and mechanisms of regulation based on the analysis of indicators of laboratory blood tests. Evaluate the results of hematocrit . Determine the amount of hemoglobin, color index, blood groups of the ABO system and draw conclusions. The solution binding situational problems thematic module with 11 different difficulty levels, including tests "Step 1".	**2**
34	***Topic 34. Research of physiological properties of cardiac muscle.*** General characteristics of the circulatory system, its role in the body**.** The structure of the heart, its functions. Cardiac muscle, its structure, functions Physiological properties of the myocardium and their features **.** Automaticity of the heart **.** The action potential of atypical cardiomyocytes of the driver of the heart rhythm - sinoatrial node. Leading system, its functional features, the rate of excitation of the heart structures. The action potential of typical cardiomyocytes . Periods of refractoriness . Mechanisms of cardiomyocyte contraction and relaxation .	**2**
35	***Topic 35. Research of dynamics of excitation of heart. ECG registration*** Dynamics of excitation in the heart. Physiological bases of electrocardiography. Normal ECG.	**2**
36	***Topic 36. Research of dynamics of excitation of heart. Electrocardiogram analysis.*** Basic principles of ECG analysis. Definition of heart rate, irritability sources, electric axis of the heart, the heart turns.	**2**
37	***Topic 37. Study of the physiological properties of the heart on the ECG.*** Evaluation conductivity automaticity , excitability of heart by ECG.	**2**
38	***Topic 38. Research of pump function of heart, heart tones. PCG.*** Cardiac cycle, its phase structure. Blood pressure in the heart cavities and the operation of the valvular apparatus during cardiac activity. Systolic and minute blood volumes, cardiac index. The work of the heart. Physiological bases of research methods: electrocardiography, phonocardiography, echocardiography , others.	**2**
39	***Topic 39. Research of arterial pressure and pulse in the person.*** Blood pressure: arterial (systolic, diastolic , pulse, average), capillary, venous. Factors that determine the amount of blood pressure. Physiological basis of blood pressure measurement in experiment and clinical practice. Arterial pulse, its main parameters. Sphygmogram, its evaluation.	**2**

40	***Topic 40. The role of blood vessels in blood circulation. Laws of hemodynamics. Rheography.*** Systemic circulation. Basic laws of hemodynamics. The mechanism of formation of vascular tone. Total peripheral vascular resistance. Factors that ensure the movement of blood through the vessels of high and low pressure. Linear and volumetric blood flow velocities in different parts of the vascular bed. Time of complete blood circulation. Functional classification of blood vessels. Physiological characteristics of vessels of compression, resistance (resistive). Microcirculation. Morpho-functional characteristics of microcirculatory vessels. The movement of blood in the capillaries, its features. Blood pressure in the capillaries. Mechanisms of fluid and other metabolism between blood and tissues Physiological characteristics of capacitive vessels. Features of venous blood flow. Venous pulse. Return of blood to the heart. Blood depot, its relativity.	**2**
41	***Topic 41. Research of regulation of activity of heart and regulation of blood circulation.*** Regulation of cardiac activity: myogenic , nervous, humoral. Dependence of the force of heart contraction on the length of cardiomyocytes (Frank-Starling's heart law), heart rate (Boudich's stairs) and resistance to blood expulsion (Anrep's law). Mechanisms of influences of parasympathetic and sympathetic nerves on physiological properties of heart muscle. Mechanisms of influence of ionic composition of blood plasma on activity of heart. Mechanisms of influence of hormones on heart activity: catecholamines , thyroxine and triiodothyronine , glucagon , others. Features of the structure and function of vascular smooth muscle. Vascular tone and its regulation, nervous and humoral mechanisms. Features of mechanisms of regulation of vessels of a microcirculatory channel. Regulation of local blood flow. The role of substances secreted by the endothelium in the regulation of vascular tone. Cardiovascular center, its structure, afferent and efferent connections. The concept of a single hemodynamic center (Frolkis VV). The main reflexogenic zones, baroreceptors and chemoreceptors of the carotid sinus and aortic arch, their role. Reflexes from receptors of auricles and large veins. Pressor and depressive reflexes. Interrelated mechanisms of nervous and humoral regulation of heart activity, vascular tone and circulating blood volume in different adaptive reactions. Physiological prerequisites for blood pressure disorders. Nervous and humoral mechanisms of blood pressure regulation. Regulation of blood circulation when changing body position. Regulation of blood circulation during physical work. Age features of blood circulation and its regulation. Physiological features of regional blood circulation: pulmonary, coronary, cerebral, abdominal. Fetal circulation. Changes in blood circulation after birth.	**2**
42	***Topic 42. The solving of situational problems with thematic module 12. Practical skills on the physiology of the circulatory system.*** The solution binding situational problems thematic module with 12 different difficulty levels, including tests "Step 1". Draw diagrams of PD of the driver of the heart rhythm of the sinoatrial node (CA), typical cardiomyocytes of the ventricles of the heart and explain the mechanisms of their development. Analyze and interpret normal ECG, FCG, SFG, blood pressure, the structure of the cardiac cycle. To draw schemes of contours of regulation of systemic circulation at various physiological states of an organism. To interpret the role of the peculiarities of regional blood circulation and its regulation (pulmonary, coronary, cerebral, abdominal) to ensure the adaptive response.	**2**
43	***Topic 43. Research of external respiration.*** Structure and functions of the respiratory system. The value of respiration for the body. The main stages of the respiratory process. External respiration. Respiratory cycle. Physiological characteristics of the respiratory tract, their	**2**

	functions. The value of the ciliated epithelium. Biomechanics of inhalation and exhalation. Pressure in the pleural cavity, its changes during respiration. Elastic properties of the lungs and chest walls. Surface tension of alveoli, its mechanisms. Surfactants , their significance. Static and dynamic indicators of external respiration.	

44	***Topic 44. Pulmonary ventilation. Gas exchange. Transport of blood gases .*** The composition of inhaled, exhaled, alveolar air. Relative constancy of alveolar air composition. Tension of gases dissolved in the blood. Partial pressure of gases (PCO_2, PO_2) in alveolar air. Mechanisms of gas exchange between inhaled air and alveolar gas mixture, between alveoli and blood in pulmonary capillaries. Properties of the pulmonary membrane. Diffusion capacity of the lungs. Relationship between pulmonary circulation and pulmonary ventilation. Anatomical and physiological "dead space". Hemoglobin. Myoglobin. Oxyhemoglobin dissociation curve, factors influencing oxyhemoglobin formation and dissociation. Oxygen and carbon dioxide content in arterial and venous blood. Oxygen capacity of blood. Formation and dissociation of bicarbonates and carbohemoglobin. ZNA - tions carbonic anhydrase . Gas exchange between blood and tissues. The voltage of oxygen and carbon dioxide in the tissue fluid and cells.	**2**
45	***Topic 45. Regulation of respiration.*** CNS structures that provide respiratory periodicity. Structures of the hindbrain: dorsal respiratory group of neurons, its role in generating the basic rhythm of respiration and regulation of respiration; ventral respiratory group of neurons, its role. The role of the pneumotactic center in the inhibition of inspiration, regulation of volume and respiration rate. Apnea center, its role. Influence of gas composition and arterial blood pH on respiration rate and depth. Central and peripheral chemoreceptors, their importance in providing gas homeostasis. Changes in lung ventilation in hypercapnia , hypoxia. Stretch receptors, their importance in the regulation of respiration. Goering-Breyer reflex . The role of other receptors in the regulation of respiration: irritants , j-receptors, proprioceptors . Protective respiratory reflexes. Regulation of respiratory resistance. Arbitrary regulation of respiration. Breathing during physical work, at high and low barometric pressure. Regulation of the first breath of a newborn child. Age features of respiration.	**2**
51	***Topic 51. Solving situational problems and practical skills in the physiology of the respiratory system.*** Assess the state of each of the stages of respiration and mechanisms of regulation based on the analysis of parameters that characterize the functions of the stages of respiration. Evaluate indicators of spirometry, spirography, pneumotachometry . The solution · binding situational problems thematic module with 13 different difficulty levels, including tests "Step 1"	**2**
46	***Topic 46. Research of the basic energy exchange. Research of the general energy exchange.*** General concepts of metabolism in the body. Metabolism between the body and the environment as the basic conditions of life and preservation of homeostasis. Plastic and the energy - -energy role of nutrients. Balance of income and expenditure of substances. Energy metabolism. The body as an open thermodynamic system Energy balance of the body. Physical calorimetry. Caloric value of various nutrients (physical and physiological). Direct and indirect calorimetry (study of energy consumption by means of the full and incomplete gas analysis). Caloric ratio of one liter of oxygen. Respiratory rate. The basic exchange, size, conditions of its research. Specific-dynamic action of nutrients. Work exchange. Energy costs of the body in different types of work. Age esp - opportunities to. Physiological norms of nutrition. The need for proteins, fats, carbohydrates depending on age, type of work and body condition (pregnancy, lactation and others).	**2**

47	***Topic 47. Thermoregulation.*** Constant temperature of the internal environment as a necessary condition for the normal state of metabolic processes. Poikilothermia , homoiothermia . Human body temperature, its daily fluctuations. The temperature of various areas of skin and internal organs. Physical and chemical thermoregulation. Metabolism as a source of heat generation. The role of individual organs in heat production. Heat transfer. Methods of heat transfer from the body surface (radiation, conduction, convection, evaporation). Physiological mechanisms of heat transfer (blood flow in the vessels of the skin, sweating and others). Thermoregulation center. Peripheral and central thermoreceptors. Nervous and humoral mechanisms of thermoregulation. Regulation of body temperature with changes in ambient temperature. Physiological bases of hardening. Age and sex features of thermoregulation.	**2**
48	***Topic 48. Study of digestion in the oral cavity. The role of taste and olfactory sensory systems.*** Structure and functions of the digestive system. Digestive tract 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 the digestive system. Digestive tract motility. Features of the structure and functions of the smooth muscles of the digestive tract. Physiological bases of methods of research of functions of the digestive tract. Digestion in the oral cavity. Mechanical and chemical processing of food. Salivation. The amount, composition and properties of saliva, its importance in digestion, mechanisms of secretion (primary, secondary saliva). Regulation of saliva secretion. Chewing, its features depending on the type of food, regulation of chewing. Swallowing, its phases, regulation. The role of the taste sensory system. Receptor, conduction and cortical departments. Types of taste sensations, importance for digestion. Interaction with the olfactory sensory system, the importance of this in determining the nature of food.	**2**
49	***Topic 49. Study of digestion in the stomach*** . Secretory activity of gastric glands. Research methods. Composition and properties of gastric juice. Mechanisms of secretion of hydrochloric acid, enzymes, mucus and their regulation. Nervous and humoral regulation of gastric secretion, phases of secretion regulation: cephalic, gastric, intestinal. Adaptive changes of gastric secretion. Motor function of the stomach, its regulation.	**2**
50	***Topic 50. Study of digestion in the duodenum.*** Exocrine activity of the pancreas. The amount , composition and properties of pancreatic juice, its role in digestion. Nervous and humoral regulation of pancreatic secretion. Phases of secretion regulation: cephalic, gastric, intestinal. The role of the liver in digestion. The formation of bile, its composition and properties. Research methods. Hepatic and gallbladder bile. Involvement of bile in digestion. Regulation of bile formation and its secretion into the duodenum.	**2**
51	***Topic 51. Research of digestion in intestines. Absorption.*** Intestinal secretion, composition and properties of intestinal juice, its role in digestion. Research methods. Regulation of intestinal secretion. Cavity and membrane hydrolysis of nutrients. 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 secretory and motor functions of the intestine. Digestion in the colon. The role of intestinal microflora. Motility of the colon, its regulation. Act of defecation. Suction processes. Research methods. Absorption of substances in different parts of the digestive tract, its mechanisms. Features of absorption of water,	**2**

	salts, carbohydrates, proteins, fats, vitamins and other substances. Suction regulation. Physiological bases of hunger and satiety. Food motivation. Representation of the food center. The contour of regulation of maintaining the stability of the content of nutrients in the internal environment.	

52	***Topic 52. Research of the role of the kidneys in the processes of excretion. Mechanisms of urination and urination.*** Selection system, its structure, functions. Excretory organs (kidneys, skin, lungs, digestive tract), their participation in maintaining homeostasis. Kidneys as the main organs of the excretory system. Nephron as a structural and functional unit of the kidney. Circulation in the kidney, its features. The main processes of urination: filtration, reabsorption, secretion. Filtration mechanisms, composition of primary urine. Filtration speed regulation. Reabsorption in tubules, its mechanisms. Rotary - countercurrent - multiple system, its role. Secretory processes in the proximal and distal tubules and collecting tubules. Final urine, its composition, quantity. Purification coefficient (clearance) and determination of filtration rate, reabsorption, secretion, renal plasma circulation and blood circulation.	**2**
53	***Topic 53. Research of regulation of urination. Clinical analysis of urine. Study of the involvement of the kidneys in maintaining homeostasis.*** Regulation of urination. Urination and its regulation. Participation of the kidneys in maintaining nitrogen balance, homeostasis parameters. Regulation of the stability of the osmotic pressure of the internal environment, the role of vasopressin. Mechanisms of thirst. Regulation of the stability of the concentration of sodium ions, potassium, water volumes and circulating blood in the body with the participation of the kidneys: the role of renin - angiotensin - aldosterone system, atrial natriuretic hormone. Regulation of the stability of the concentration of calcium ions and phosphates with the participation of the kidneys. The role of the kidneys in the regulation of the acid-base state of the internal environment. Physiological bases of methods of research of function of kidneys. Age-related changes in urination and urination	**2**
54	***Topic 54. Final computer contro: content modules 11-17.*** Consolidation of acquired knowledge and their verification.	**2**
	Together	**108**

Individual work

№	Topic	Number of hours
1.	**Practical classes training –** theoretic training and mastering of practical skills (according practical classes plan)	**27**
2	Elaboration of topics that are not included in the lesson plan	
	History of the development of physiology in the XIX century. 1. Characteristics of the development of physiology. 2. The role of the works of W. Harvey , R. Descartes. 3. Formation and development of physiology in the XIX century (K. Bernard , E. Dubois-Raymond , W. Cannon , K. Ludwig, C. Sherrington).	**10**
	The contribution of the works of IM Sechenov, IP Pavlov, PKAnokhin, PG Kostyuk in the development of world physiology. The contribution of the works of IM Sechenov, IP Pavlov, ME Vvedensky , OO Ukhtomsky , L.A. Orbeli , PK Anokhin, PG Kostyuk in the development of world physiology. .	**4**
	Ukrainian School of Physiology Ukrainian School of Physiology - V.Ya. Danilevsky, V.Yu. Chagovets , DS Vorontsov, PM Serkov , PG Kostyuk , VI Skok , MF Shuba, GV Folbort , W.W. Frolkis , P.G. Bogach , O.O. Мойбенко	**10**
	Physiological bases of labor activity. 1. Processes of fatigue and recovery during muscular work. 2. Adaptation of the body to physical activity. 3. Optimal modes.	**40**
	Dynamics of lymph circulation 1. Lymph, its composition, quantity, function. 2. Mechanisms of lymph formation and movement in lymphatic vessels.	**10**
	Physiology of regional blood circulation 1. Physiological features of regional blood circulation: pulmonary, coronary, cerebral, abdominal. 2. Fetal circulation. 3. Changes in blood circulation after birth. 4. Cerebral circulation 5. Pulmonary circulation 6. Intestinal circulation 7. Renal circulation 8. Muscular circulation	**10**
	Together	**84**
3	**Training for Final semester attestation**	**15**
	Together	**126**

Individual tasks

Not provided

The list of theoretical questions for preparation of applicants for higher education for the semester final certification

1. Rest potential, mechanisms of origin, its parameters, physiological role.
2. Action potential, mechanisms of origin, its parameters, physiological role.
3. Mechanisms of excitation by nerve fibers.
4. Patterns of excitation by nerve fibers.
5. Mechanisms transfer through nerve-excitation of the muscle synapse .
6. Mechanisms of contraction and relaxation of skeletal muscles.
7. Types of muscle contractions: single and tetanic; isotonic and isometric.
8. Types of central braking. Mechanisms of development of presynaptic and postsynaptic inhibition.
9. Motor reflexes of the spinal cord, their reflex arcs, physiological significance.
10. Motor reflexes of the hindbrain, their physiological significance.
11. Motor reflexes of the midbrain, their physiological significance.
12. Cerebellum, its functions, symptoms of damage.
13. Synapses of the autonomic nervous system, their mediators, cytoreceptors and blockers of excitation transmission in synapses .
14. Influence of the sympathetic nervous system on visceral functions.
15. Influence of parasympathetic nervous system on visceral functions.
16. Types of higher nervous activity (temperaments).
17. Erythrocytes, their norm, dependence on age and sex, functions. Physiological erythrocytosis .
18. Types of hemoglobin and its compounds, their norm, dependence on age and sex, physiological role.
19. Leukocytes, their types, norm, and functions. Physiological leukocytosis .
20. Platelets their norm and physiological role. Vascular platelet hemostasis, its stages and physiological significance.
21. Physiological characteristics of the ABO blood system. Conditions of blood compatibility of donor and recipient.
22. Automaticity of the heart. Gradient of automatism.
23. Conductive system of the heart. Conduction and speed of excitation in the heart.
24. Cardiac cycle, its phases, their physiological role.
25. Heart tones, mechanisms of their origin.
26. Arterial pulse, its origin and characteristics, their norms.
27. Blood pressure, norm, factors that determine its value. Methods of blood pressure registration.
28. Reflex regulation of blood circulation: describe the methods and mechanisms of influence (Danini-Ashner , Chermak , Goltz reflex , orthostatic)

29. External respiration. External respiration rates and their evaluation.

30. The basic exchange and conditions of its definition, the factors influencing its size.

31. Methods of heat transfer of an organism, their regulation.

32. The composition of saliva, its role in digestion. Regulation of salivation. Influence of stimulus properties on the quantity and quality of saliva.

33. The composition and properties of gastric juice.

34. Phases of regulation of gastric secretion.

35. The composition and properties of pancreatic juice. Phases of regulation of secretory function of the pancreas.

36. Composition and properties of bile. Regulation of bile formation and secretion. Mechanisms of bile flow into the duodenum.

37. Mechanisms of urination. Glomerular filtration and the factors on which it depends.

38. Reabsorption and secretion in the nephron, their physiological mechanisms.

39. Coagulation hemostasis, its mechanisms and physiological significance.

40. Anticoagulants and fibrinolysis, their physiological significance.

List of practical skills for the final semester attestation

1. Evaluate the indicators of the complete blood count.
2. Analyze the physiological properties of the heart on the ECG

The form of final control of academic success is FSA

Control methods

- oral control;
- written control;
- test control;
- programmable control;
- practical inspection;
- self-control;
- self-esteem.

Types of control:

- **previous (weekend)** - is conducted immediately before training and allows you to correctly assess the initial level of knowledge of the applicant and plan training;
- **current** - is carried out at each lesson and allows you to identify the level of mastery of individual elements of educational material;
- **thematic (stage)** ;
- **final** - serves to test and evaluate knowledge, skills and abilities in a particular discipline.

Current and final control system

Control measures for assessing the educational activities of higher education applicants include incoming, current and final control of knowledge, skills and abilities. Final control includes semester control and state certification of the

applicant for higher education.

Control measures are based on the principles of: compliance with higher education standards; use of a standardized and unified diagnostic system aimed at the application of knowledge; definition of evaluation criteria; objectivity and transparency of control technology. The final assessment of learning outcomes is carried out on a single 200-point scale. The assessment of the applicant corresponds to the ratio of the level of professional and general competencies established in the assessment to the planned learning outcomes (as a percentage). At the same time, standardized generalized criteria for assessing the knowledge of higher education applicants are used.

Standardized generalized criteria for assessing the knowledge of higher education applicants

For 4-point scale	Assessment in ECTS	Evaluation criteria
5 (excellent)	A	The higher education applicant shows special creative abilities, is able to acquire knowledge independently, without the help of the teacher finds and processes the necessary information, is able to use the acquired knowledge and skills for decision-making in unusual situations, convincingly argues answers, independently reveals own talents and inclinations, has not less than 90 % knowledge of the topic both during the survey and all types of control.
4 (good)	B	The higher education applicant fluent studied volume of material, apply it in practice, freely solution of exercises and tasks in standardized situations, self-correcting errors, whose number is small, has no less than 85% of knowledge on the subject as the survey, and all controls .
	C	The higher education applicant is able to compare, summarize, systematize information under the guidance of a scientific and pedagogical worker, in general, independently apply it in practice, control their own activities; to correct mistakes, among which there are significant ones, to choose arguments to confirm opinions, has at least 75% knowledge of the topic both during the survey and all types of control.
3 (satisfactory)	D	The higher education applicant reproduces a significant part of the theoretical material, shows knowledge and understanding of the basic provisions with the help of research and teaching staff can analyze educational material, correct errors, among which there is a significant number of significant, has at least 65% knowledge of the topic, and all types of control.

	E	The higher education applicant has educational material at a level higher than the initial, a significant part of it reproduces at the reproductive level. has at least 60% knowledge of the topic both during the survey and all types of control.
2 (unsatisfactory)	FX	The higher education applicant has the material at the level of individual fragments that make up a small part of the material, has less than 60% knowledge of the topic both during the survey and all types of control.
	F	The higher education applicant has the material at the level of elementary recognition and reproduction of individual facts, elements, has less than 60% knowledge of the topic as during the survey, and all types of control.

Evaluation of current educational activities

Assessment of current educational activities is carried out by scientific and pedagogical (pedagogical) employees during practical classes. The main purpose of current control is to provide feedback between the researcher and the applicant in higher education in the learning process and the formation of learning motivation of higher education. The information obtained during the current control is used both by the researcher and pedagogical worker - to adjust technologies, methods and teaching aids, and by higher education applicants - to plan independent work.

Current control can be carried out in the form of oral interviews, solving situational problems, assessment of manipulations, written control, written or software computer testing in practical classes, assessment of performances of higher education applicants during the discussion, etc.

Conducting a semester exam (FSA)

Applicants take semester exams during the examination sessions provided by the curriculum.

Semester exams are held according to a separate schedule, which is approved by the first vice-rector for scientific and pedagogical work. The schedule of examinations is brought to the notice of scientific and pedagogical workers of departments and applicants of higher education not later than a month before the beginning of examination session.

The time of self-preparation of higher education applicants for the exam is at least 2 days.

Before each exam, the department must organize consultations. The schedule of pre-examination consultations, time and place of the examination the department informs the applicants for higher education not later than 2 weeks before the examination session.

Applicants for higher education are admitted to the exam, who have not missed missed classes, scored a minimum of at least 72 (which corresponds to an average score of 3.0 for current performance), passed all PMK in the discipline (except the last and met all the requirements of the academic disciplines that are provided by the working curriculum of the discipline (admission to the PMC in the form of test control, etc.), fulfilled financial obligations under the agreements (for study, living in a dormitory, etc.), which received a mark in the individual training plan for admission to the session of the dean (deputy dean) of the faculty.

Admission to the semester exam is not affected by academic arrears in other disciplines.

Semester exams are accepted by a commission , in accordance with the "Regulations on the examination commission". Examinations are open and public. Grades obtained during the examination by the attested persons are set out in the " Statement of final semester control " and in the individual plans of applicants for higher education .

The exam is held in one day in two stages: computer testing and theoretical component. In the first stage examination day in the Cathedral computer lab (room and electronic testing sessions missed university) higher education applicants are tested for 20 issues (time to complete - 20 minutes) from the base of KTI-1, KTI -2 for discipline. Each correct answer for the test task when compiling the computer

control is counted as 1 point (maximum in the amount for the first stage, respectively 20 points). The result of the computer control by the applicant of higher education is not a ground for not admitting him to the theoretical part of the examination. The examination ticket contains three specific basic theoretical (practice-oriented) questions, formulated in such a way that the reference answer of the higher education applicant to each approximately lasts up to 3-5 minutes. Each question of the examination ticket is evaluated within 0-20 points.

As a result of passing the computer control and the theoretical part of the exam, the higher education applicant is given a total score from 0 to 80 points, the conversion of points into the traditional score is not carried out. In case of violation by the applicant of higher education of the rules of academic integrity (p.2.2.5. Rules of Procedure) during the exam, the results are canceled, the applicant of higher education for the answer is graded "unsatisfactory" (0 points).

If a higher education applicant receives negative marks in exams in three disciplines, he is subject to expulsion from the university .

In case of disagreement of the applicant with the grade obtained for the exam, the applicant has the right to file an appeal (in accordance with the " Regulations on the appeal of the results of the final control of knowledge of applicants for higher education").

The applicant of higher education has the right to retake the exam no more than 2 times and only during the examination session.

The result of re-taking the exam is certified by the signatures of all members of the commission in the test-examination statement.

Applicants for higher education who have not passed the exam within the prescribed period are subject to expulsion from the university.

Grade for the discipline

The grade in the discipline is set by the department on a traditional (national) 4-point scale. The grade from the discipline is not displayed (not converted) into ECTS grades.

If the applicant has not passed at least one final module test before the beginning of the new semester, he receives for the discipline the traditional grade "2" and ECTS grade "F", which is the basis for deduction.

Unified table of correspondence of scores for current performance, scores for FMC, exam, and traditional four-point score.

Average score for current performance (A)	Points for current success in the module (A * 24)	Points for PMK from the module (A * 16)	Points for the module and / or exam (A * 24 + A * 16)	Category ECTS	By 4-point scale
2	48	32	80	**F FX**	**2 unsatisfactorily**
2.1	50	34	84		
2.15	52	34	86		
2.2	53	35	88		
2.25	54	36	90		
2.3	55	37	92		

2.35	56	38	94		
2.4	58	38	96		
2.45	59	39	98		
2.5	60	40	100		
2.55	61	41	102		
2.6	62	42	104		
2.65	64	42	106		
2.7	65	43	108		
2.75	66	44	110		
2.8	67	45	112		
2.85	68	46	114		
2.9	70	46	116		
2.95	71	47	118		
3	72	50	122	**E**	**3 satisfactorily**
3.05	73	50	123		
3.1	74	50	124		
3.15	76	50	126		
3.2	77	51	128		
3.25	78	52	130	**D**	
3.3	79	53	132		
3.35	80	54	134		
3.4	82	54	136		
3.45	83	55	138		
3.5	84	56	140		
3.55	85	57	142		
3.6	86	58	144	**C**	**4 fine**
3.65	88	58	146		
3.7	89	59	148		
3.75	90	60	150		
3.8	91	61	152		
3.85	92	62	154		
3.9	94	62	156		
3.95	95	63	158		
4	96	64	160	**B**	
4.05	97	65	162		
4.1	98	66	164		
4.15	100	66	166		
4.2	101	67	168		
4.25	102	68	170		
4.3	103	69	172		
4.35	104	70	174		
4.4	106	70	176		
4.45	107	71	178		
4.5	108	72	180	**A**	**5 perfectly**
4.55	109	73	182		
4.6	110	74	184		
4.65	112	74	186		

4.7	113	75	188		
4.75	114	76	190		
4.8	115	77	192		
4.85	116	78	194		
4.9	118	78	196		
4.95	119	79	198		
5	120	80	200		

Teaching methods

- methods that provide perception and assimilation of knowledge by applicants for higher education (lectures, independent work, instruction, consultation);
- methods of application of knowledge and acquisition and consolidation of skills and abilities (practical classes, control tasks);
- methods of testing and assessing knowledge, skills and abilities;
- **explanatory-illustrative** or **information-receptive** , which involves the presentation of ready-made information by the teacher and its assimilation by applicants for higher education ;
- **reproductive** , which is based on the performance of various tasks on the model;
- **method of problem presentation,** which is that the teacher poses a problem and solves it himself, demonstrating the contradictions that characterize the process of cognition, while the task of higher education is to control the sequence of presentation of material, materiality of evidence, predicting the next steps of the teacher; this MN is implemented by training applicants for higher education in problematic situations in order to successfully prepare for future work in real conditions of practical medical institutions;
- **partial-search** or **heuristic** , aimed at mastering certain elements of search activity, for example: the teacher formulates the problem, graduates - a hypothesis
- **research** , the essence of which is to organize the teacher of creative research activities of higher education seekers by setting new problems and problems.

Methodical support

1. Working curriculum
2. Syllabus
3. Materials for control of knowledge, skills and abilities of applicants for higher education :
    a. tests of different levels of difficulty
    b. tests from the bank of licensing exams "Step - 1"
    c. situational tasks
    d. computer control programs
4. Videos.
5. Multimedia presentations of lectures.
6. Tools for the practical part of the lesson.

Recommended Books

Basic:

1. Філімонов, Володимир Іванович. Фізіологія людини [Текст] : підручник

[для студентів мед. закладів фахової передвищої та вищої освіти] / В. І. Філімонов. - 4-те вид. - К. : Медицина, 2021. - 488 с. :
2. Фізіологія : підручник для студентів вищих медичних навчальних закладів IV рівня акредитації / В. Г. Шевчук [та ін.] ; за ред. В. Г. Шевчука. - 5-те вид. - Вінниця : Нова кн., 2021. - 447 с.
3. Клінічна фізіологія : підручник для студентів, магістрів, лікарів-інтернів медичних закладів вищої освіти / Філімонов В. І. [та ін.] ; за ред. К. В. Тарасової. - 2-ге вид., переробл. і допов. - Київ : Медицина , 2022. - 775 с.
4. Фізіологія. Короткий курс : навчальний посібник для медичних і фармацевтичних ВНЗ / В. М. Мороз [та ін.] ; за ред. В. М. Мороза, М. В. Йолтухівського. - 2-ге вид., допов. і переробл. - Вінниця : Нова Кн., 2019. - 390 с.
5. Медична фізіологія за Гайтоном і Голлом: підручник: пер з анг 14-го вид.: у 2 т Т 1 Для студентів мед ЗВО, лікарів-інтернів, аспірантів, фахівців-практиків/ Джон Е Голл ,Майкл Е Голл, наук.ред. укр. Вид. Степан Вадзюк-К., 2022-XIV, 634с.,тв. Пал.,(ст.пр)

English language:

Main (Основна):

1. Zaporozhets T.N,Rud M.V,Sukhomlyn T.A. Physiology Module 1. General physiology and high integrated functions .-Poltava, 2018-192p
2. Zaporozhets T.N,Rud M.V,Sukhomlyn T.A Physiology Module 1. General physiology and high integrated functions Publishing «Magnolia 2006» Lviv 2019-188p
3. Zaporozhets T.M., Sukhomlyn T.A., Sukhomlyn A.A. Blood system Physiology //Educationfl guidelines for student of medical and dental faculties. Module2. Blood system physiology.- Poltava Copy-Servis,2022- 130p
4. Vadzyuk, S. General physiology of exitable tissues. Neural and humoral regulation of organism functions : Textbook / S. Vadzyuk, S. Nakonechna ; Ministry of Education and Science of Ukraine, I. Horbachevsky Ternopil National Medical University, Physiology with the Basics of Biosafety and Bioethics. - Ternopil : TNMU „Ukrmedknyha“, 2020. - 224 p
5. Physiology / ed.: V. M. Moroz, O. A. Shandra. - 5th ed. - Vinnytsia : Nova Knyha, 2020. - 722 p.

Additional (додаткова):

1. Zaporozhets T. Dental physiology : study manual in English / T. Zaporozhets, O. Tkachenko, S. Tryniak ; Ministry of health of Ukraine, UMSA. – Lviv : Magnolia 2006, 2019. – 166 p.
2. USMLE. Step 1. 2018. Physiology [Текст] : lecture notes / ed. L. B. Wilson ; contributor: R. Dasgupta, F. P. Noto. - New York : Kaplan Medical, 2018. - vi, 425 p.
3. Ganong’s Review of medical physiology / ed. Barret K.E., et al. - 26 th ed. - New York: McGraw Hill Education, 2019. - 727 p.
4. Guyton and Hall Textbook of Medical Physiology / ed. Hall J.E. et al. - 14th ed. - Philadelphia : Elsevier, 2020. - 1152 p.

Information resources

1. Smirnov VM Human physiology [Electronic resource] / Smirnov VM. - 2012. - Mode of access to the resource: 7. http://emed.org.ua/knigi/113-fiziologija/2285-fiziologija-ljudini-smirnov-vm- 2002 .

2. Ganong VF Human physiology [Electronic resource] / VF Ganong . - 2002. - Mode of access to the resource: http://kingmed.info/knigi/Fiziologia/book_233/Fiziologiya_lyudini-Ganong_VF-2002-djvu .
3. Shevchuk VG Physiology. Textbook / [Electronic resource] / VG Shevchuk. - 2005. – Resource access mode: http://kingmed.info/knigi/Fiziologia/book_2365/Fiziologiya-Shevchuk_VG_Moroz_VM_Belan_SM-2012-djvu .

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