MINISTRY OF EDUCATION AND SCIENCE OF THE RUSSIAN FEDERATION

PENZA STATE UNIVERSITY

MEDICAL INSTITUTE

APPROVED:
Director of the Medical Institute
_____ A.N. Mitroshin
"24" марта 2016 г.

STUDY PROGRAMME

C1.1.18 Normal physiology

Course – 31.05.01 General Medicine

Graduate's Degree – Medical Doctor

Type of study – full-time

Penza, 2016

1. Objectives of the discipline

The purpose of discipline "Normal physiology" is providing of students with fundamental knowledge about the physiological mechanisms underlying vital functions of human organism, and acquirement of practical skills to explore and evaluate the functional state of the body's systems. As a result, the student is able to learn the fundamental and applied knowledge which are necessary in the study of pathological physiology and clinical disciplines.

The objectives of the Normal physiology are:

- The study of individual systems of the organism;
- The ability to synthesize knowledge about the mechanisms of functioning of individual systems of the human body to build a model of functional system of its vital function;
- The understanding of morphofunctional unity of the human body. The understanding of the mechanisms of functioning of its various systems;
- The formation of ideas about the organism as a single functional system, directed to preserving of the individual in a changing environment;
- The ability to use the knowledge gained in the study of theoretical and practical disciplines.

2. The place of discipline in the structure of the basic professional educational programs

Academic discipline "Normal physiology" relates to the base part of the C1 block.

Normal physiology based on the knowledge obtained during the study of courses such as Biology, Chemistry, Human Anatomy, Histology, Cytology, Embryology.

Competencies acquired during the study of physiology, prepare the student for development of professional competencies. Fundamentals of discipline should be used for further study of the following disciplines: "Pharmacology", "Pathophysiology, clinical Pathophysiology ", clinical disciplines.

3. Competences of the student, formed as a result of studying the discipline "Normal physiology"

The process of studying the discipline is directed to form the following the elements in accordance with the Federal State Educational Standards of Higher Education:

Code of competence	Name of competence	Structural elements of the competence (knowledge, skill, application as a final learner outcome)
GEC-1	ability to abstract thinking, analysis, synthesis	To know: the foundations of a healthy lifestyle; the content of concepts such as "health", "quality of life", "disease risk factors"; anatomical and physiological and psychological characteristics of a person; outstanding figure of the medicine and the history of development of medical science.
		To be able to: analyze and identify problems of the person at different ages, associated with lack of knowledge and skills in health promotion sector; use sports and recreational activities to promote health, achieve life and career goals.
		To own: biomedical conceptual apparatus; basics of scientific and technical information of medical topics; basics on the analysis of the results of clinical, laboratory and instrumental methods of examination of patients.

Code of competence	Name of competence	Structural elements of the competence (knowledge, skill, application as a final learner outcome)
GPC-9	the ability for evaluation of morphological and functional, physiological and pathological processes in the human body for decision of professional tasks	To know: morphological and functional characteristics of muscles, nerves, blood, cardiovascular, respiratory, digestive, excretory systems, central and peripheral nervous systems, sensory systems and the glands.
		To be able to: use the anatomical and physiological basis and evaluate the morphological, functional and physiological state of the human body, differentiated muscle tissue, parts of the central nervous system, heart, blood vessels, blood cells, airway and units of nephron.
		To own: skills of analysis hemogram, electrocardiogram, spirogram, determining blood groups, the study of reflex activity and typological features of the person.

4. The structure and content of the discipline «Normal physiology»

4.1. The structure of the discipline

General work load of the subject totals **8** credit units, **288** hours.

No.	Names of parts and topics of the discipline	Semester	Week of the semester	Types of learning, including students' out-of-class work and workload (in hours)									Forms of current assessment (divided in weeks) Class study							
				Class study				Individual work												
				Total	Lecture	Practical lessons	Laboratory classes	Total	Class study preparation	Report paper	Course work (project)	Exam preparation	Discussion	Tutorial	Tests assessment	Checking the test papers	Research paper assessment	Workbook assessment	Term paper (project)	Assessment of practical skills
	Section 1. General properties of excitable tissues																			
1	Topic 1.1. Basic concepts of physiology. Physiological methods of investigation of excitable tissues.	3	1	2		2		1	0,5		0,5		2							2
2	Topic 1.2. Modern ideas about the mechanisms of origin of the membrane potential of rest and action potential.	3	2	6	2	4		2	1,5		0,5		2							2
3	Topic 1.3. Modern ideas about the mechanism of muscle contraction	3	3	2		2		2	1,5		0,5		3							3
4	General properties of excitable tissues (seminar).	3	4	6	2	4		1	0,5		0,5			4	4				4	
	Section 2. General characteristics of the functions of the nervous system.																			
5	Topic 2.1. Mechanisms of transmission of excitation through synapses. Neuron as a structural and functional unit of the central nervous system	3	5	2		2		2	1,5		0,5		5							5

No.	Names of parts and topics of the discipline	Semester	Week of the semester	Types of learner activities, including students' individual work and workload (in hours)									Forms of current assessment (divided in weeks) Class study							
				Class study				Individual work												
				Total	Lecture	Practical lessons	Laboratory classes	Total	Class study preparation	Report paper	Course work (project)	Exam preparation	Discussion	Tutorial	Tests assessment	Checking the test papers	Research paper assessment	Workbook assessment	Term paper (project)	Assessment of practical skills
6	Topic 2.2. General principles of CNS coordination activities	3	6	6	2	4		2	1		1		6							6
7	General properties of the central nervous system (seminar).	3	7	2		2		1	0,5		0,5			7	7				7	
	Section 3. Regulation of physiological functions																			
8	Topic 3.1. Private physiology of the central nervous system. The role of different departments in the integrative activity of the brain.	3	8	6	2	4		2	1		1		8							8
9	Topic 3.2. The autonomic nervous system	3	9	2		2		2	1		1		9							9
10	Topic 3.3. Physiology of glands of internal secretion.	3	10	6	2	4		2	1		1		10							10
11	Private physiology of the central nervous system. VNS. Hormones. (seminar).	3	11	2		2		1	1					11	11				11	
	Section 4. Human life activity with different types of activity																			
12	Topic 4.1. Physiology of sensory systems.	3	12	6	2	4		2	1		1		12							12
13	Topic 4.2. Analyzers (Visual, auditory)	3	13	2		2		2	1		1		13							13
14	Topic 4.3. Analyzers (vestibular, olfactory, gustatory). Nociception.	3	14	6	2	4		2	1		1		14						14	14
15	Topic 4.4. Physiology of higher nervous activity. The biological essence of conditioned reflexes.	3	15	2		2		2	1		1		15							15
16	Topic 4.5. Behavior, psyche, learning, memory, emotions.	3	16	6	2	4		2	1		1		16							16

No.	Names of parts and topics of the discipline	Semester	Week of the semester	Types of learner activities, including students' individual work and workload (in hours)									Forms of current assessment (divided in weeks) Class study							
				Class study				Individual work												
				Total	Lecture	Practical lessons	Laboratory classes	Total	Class study preparation	Report paper	Course work (project)	Exam preparation	Discussion	Tutorial	Tests assessment	Checking the test papers	Research paper assessment	Workbook assessment	Term paper (project)	Assessment of practical skills
17	Topic 4.6. Sleep, its kinds. Individuality of a person.	3	17	2		2		1	1				17							17
18	Topic 4.7 Higher nervous activity. Thinking, consciousness, speech	3	18	6	2	4		2	1		1		18							18
19	Control exercise.	3	19	3		3		1			1			19	19				19	
	Section 5. Liquid media of the body, their functional significance.																			
1	Topic 5.1. Blood, as an internal environment of the body, its role in maintaining homeostasis. The physiology of erythrocytes.	4	1	6	2	4		2,5	2,5				2							2
2	Topic 5.2. Physiology of leukocytes.	4	2	4		4		2,5	2,5				2							2
3	Topic 5.3. Physicochemical properties of blood. Blood groups.	4	3	6	2	4		2,5	2,5				3							3
4	Topic 5.4. Physiology of blood clotting.	4	4	4		4		1	1				4							4
5	The final lesson on the section "Blood".	4	5	6	2	4		3	3					5	5					
	Section 6. The Physiology of the cardiovascular system																			
6	Topic 6.1. Physiological features and properties of the heart muscle. Regulation of the heart.	4	6	4		4		2,5	2,5				6							6
7	Topic 6.2. Features of regional circulation. Microcirculation.	4	7	6	2	4		2,5	2,5				7							7
8	Topic 6.3. Systemic blood circulation. Functional system providing maintenance of blood pressure.	4	8	4		4		2,5	2,5				8							8
9	The final lesson on the section "CVS".	4	9	6	2	4		3	3					9	9					
	Section 7. Physiology of the respiratory system																			

10	Topic 7.1. External breathing. Pulmonary volumes.	4	10	4		4		2,5	2,5				10							10
11	Topic 7.2. Regulation of respiration. Features of breathing in different conditions. Non-respiratory functions of the lungs.	4	11	6	2	4		2,5	2,5				11							11
12	Seminar on "Breathing"	4	12	4		4		3	3					12	12					
	Section 8. Physiology of the digestive system. Urinary System																			
13	Topic 8.1. Digestion, basic principles and mechanisms of its regulation. Absorption in various parts of the digestive tract.	4	13	6	2	4		3	3				13							13
14	Topic 8.2. Metabolism and energy. Food. Thermoregulation.	4	14	4		4		2,5	2,5				14							14
15	Topic 8.3. Physiology of the Urinary System	4	15	6	2	4		2,5	2,5				15							15
16	The final lesson on the sections "Digestion", "Urinary System".	4	16	4		4		3	3					16	16					
	Section 9. Physiology of the reproductive system. Adaptation-compensatory mechanisms of the body.																			
17	Topic 9.1 Physiology of the reproductive function.	4	17	6	2	4		2,5	2,5				17							17
18	Topic 9.2. Physiological basis of human labor activity. Adaptation-compensatory mechanisms of the body.	4	18	4		4		2,5	2,5				18							18
19	Topic 9.3. Control exercise.		19	5	1	4		3	3					19	19					
	Term paper	3									14									
	Exam preparation	4										36								
	Overall workload, in hours			171	38	133		117	67		14	36	Interim assessment							
													Type			Semester				
													Term paper			**3**				
													Exam			**4**				

4.2. Subject's contents.

I. GENERAL PHYSIOLOGY

Basic concepts of physiology

Organism. The unity of the organism and the external environment. Homeostasis. Homeokinesis.

Cell. Its functions. Body tissues (epithelial, connective, muscular and nervous), their functions.

Organ. Physiological characteristics. Structural and functional units, functional elements.

The physiological function. The norm of function. Age-related changes in functionality. Relations between structure and function.

Physiological basis of functions. The irritability and excitability. The excitation and inhibition. Membrane and intracellular processes.

Basic principles of formation and regulation of physiological functions.

The concept of regulation of physiological functions. Levels of regulation of physiological functions. Mechanisms of regulation of physiological functions: nervous (axon reflex, somatic, autonomic reflexes - central and peripheral), humoral (hormones, metabolites). The concept of self-regulation. The trophic function of the nervous system.

Reflex as the mechanism of respond to changes in internal and external environment. The reflex principle of activity of the nervous system (R. Descartes, G. Prohazka, I.M. Sechenov, I.P. Pavlov). Reverse afferentation. Its significance. The principles of the reflex theory (determinism, analysis and synthesis, the unity of structure and function). Classification of reflexes.

Factors of humoral regulation. Characteristics and classification of physiologically active substances. Negative feedback in the humoral regulation. Relations between the nerve and humoral mechanisms. Reception of physiologically active substances.

System organization of functions. (I.P. Pavlov, P.K. Anokhin). The levels of systemic organization. Cybernetic approach to the regulation of the processes. Scheme of the organization and system-forming factors of functional systems. Regulation and prognostication.

Age characteristics of the formation and regulation of physiological functions. The significance of the doctrine of the functions regulation for general medical and clinical disciplines. The formation of the concept of a healthy lifestyle.

Physiology of excitable tissues

The membrane potential. Its origin. Modern understanding of the structure and function of the cell membranes. Ion channels. Their classification. Ion gradients of cells, their arrangements. Local response. The action potential, its phases and their origin. Relationship of excitability phase with the phases of the action potential. Refractory and its causes. Criteria for evaluation of excitability: the threshold force, the threshold time, the critical level of depolarization. Effect of direct current on excitable tissues. The law "all or nothing", law of "force", the polar law, cathodical depression, accommodation. The law "force-time" (rheobasis, chronaxy). Lability. Parabiosis (N.E. Vvedensky). The mechanism of impulse conduction along unmyelinated and myelinated nerve fibers. Characteristics of A, B, C fibers. Electroneurogram.

Synapse. Structure and classification of synapses. The mechanism of transfer of excitation in the synapses (electrical, chemical). Mediators, their synthesis, secretion, receptor interaction. Modulators. Postsynaptic potentials. Specifics of the structure and function of the neuromuscular synapse.

Receptor. Classification of receptors and their properties. Regulation of receptor function. The concept of receptive field and reflexogenic zone. Methods of study of receptors.

Muscle. Types of muscle contractions. Single contractions. Phases. Tetanus. The dependence of the amplitude-dy of contraction and the frequency of stimulation. Optimum and pessimum. Strength and muscle work. Dynamometer. The law of medium loads. The motor unit. The modern theory of muscle contraction and relaxation. Bioelectricity, thermal and chemical processes in the muscle. Electromyography. Major differences in the structure and the functioning of smooth and skeletal muscles. Characteristic of the low excitable connective tissue (bone, cartilage).

Gland. Biopotentials of gland cells. Secretory cycle.

Physiology of CNS

Role of central nervous system in adaptive activity of the organism. Neuron as the structural and functional unit of the central nervous system. Functional elements of brain. Blood-brain barrier. Glia. Their functions. Methods of research of CNS functions. Stereotactic technique. Electrophysiological and radioimmunoassay methods. Intracerebral administration of substances (microinjection and microionophoresis). Chronoreflexometry. Neurocartography. Laws and features of excitation in the central nervous system. The spatial and temporal summation, rate of transformation, post-tetanic potentiation. Low lability of the central nervous system. Fatigue, sensitivity to neurotropic drugs. The concept of synaptic active substances.

The basic principles of spread of excitation in the central nervous system. Divergence as the animation element and the basis of irradiation of excitation. Convergence, which determines the neuron involvement in the system activity of the organism. Unilateral conduction, the central inhibition, reverberation.

Inhibition in the CNS (I.M. Sechenov, F. Golts, G. Megun). Modern understanding of the mechanisms of central inhibition (Dzh.Ekkls, Renshaw). The main types of inhibition (postsynaptic, presynaptic) and their mechanisms.

General principles of the central nervous system coordination activities (Ch.Sherrington). The interaction between the processes of excitation and inhibition as a basis of coordination. The principles of reciprocity, facilitation, occlusion, feedback and general "final track," the dominant (A.A. Ukhtomskii). Multi-level regulation of somatic and autonomic functions. The principle of interaction of projection, associative, integrative launch systems. The concept of a genetically determinated and probabilistically determinated blocks of systems of the brain. Gnosis, praxis.

Spinal cord. The role of the spinal cord in the process of regulation of the activity of the musculoskeletal system and the autonomic functions of the organism. Characteristics of the spinal animals. The functions of the front and rear roots. Segmental and intersegmental principles of the spinal cord. Spinal cord centers. Clinically significant spinal reflexes in humans, H-reflex. Spinal mechanisms of regulation of muscle tone and movement phase. Conduction function of spinal cord. Place of the spinal cord in the system hierarchy of the central nervous system.

Medulla oblongata and pons. Segmental and suprasegmental principles of structural and functional organization. The centers of the medulla oblongata and the pons, their participation in the self-regulation processes. The role of the medulla oblongata in the regulation of muscle tone. Reflexes of posture (labyrinth, neck, eye fixation). Conduction function of the medulla oblongata and ponts. Participation of the medulla oblongata and the ponts in the integrative activity.

Midbrain. The role of the midbrain in the processes of self-regulation of functions. Functions of quadrigemina, red nucleus, substantia nigra, nucleus of III, IV pairs of cranial nerves, blue spots, the central gray matter. Involvement of the midbrain in the implementation of the phase-tonic muscle activity. Static reflex and statokinetic reflexes (R.Magnus). Orienting reflex. The mechanism of maintaining the equilibrium of the body. Condaction function of the midbrain.

Cerebellum. Afferent and efferent connections. Corrective and stabilizing effect on the motor function of the cerebellum. Participation in the organization of motor programs. The role of inhibitory neurons in the cerebellar cortex. The relationship between the cortex and the cerebellum nuclei and the vestibular nucleus. Antigravity function. Participation in the regulation of autonomic functions (L.A.Orbeli).

Reticular formation. Features of the neural organization of the reticular formation of the brain stem. Decreasing influence of the reticular formation on the reflex activity of the spinal cord (I.M. Sechenov, V.M. Bekhterev, G. Megun). Participation and redistribution in maintaining of muscle tone (R.Granit). The significance of the reticular formation in the regulation of autonomic functions. Rising activating influence (G.Megun, Giuseppe Morutstsi). The role of reticular mechanisms in the processing of sensory information, processes of wakefulness and sleeping. The participation of the reticular formation in the integrative activity of the central nervous system.

Thalamus as a collector of afferent pathways. Functional characterization of specific (relay, associative) and nonspecific nuclei. Somatotopical organization of receptor fields in the relay nuclei. The role of the overlap in their exteroceptive and interoceptive fields in formation of "reflected sensitivity" (G.A.Zaharin, H.Ged, R.A.Durinyan).

Thalamocortical and corticothalamical relationship. Hypothalamus. Characteristics of the main nuclear groups. Features of neurons (neuro-reception, neurosecretion, plblood supply). Hypothalamus - the highest subcortical autonomic center, providing the integration of somatic, autonomic and endocrine functions. Role of hypotalamus in the management of homeostatic processes. Participation in the formation of motivation, emotion, stress, biorhythms.

The limbic system. The role in the formation of motivation, emotion, memory organization. Participation in the self-regulation of autonomic functions.

The basal nuclei. The role in the formation of motor programs. The functions of the striatum, the interaction with the black substance and other structures of the extrapyramidal system. Significance of dopaminergic and other connections. Bilateral relations of the caudate nucleus with the cerebral cortex.

The cerebral cortex. The role of the cortex in the formation of the system octivity of organism. Afferent, efferent and association areas of the cortex. Columns organization of the cortex. Modern understanding of the localization of functions in the cortex. Polyfunctionality of cortical areas. Irradiation and the convergence of the excitation of different modalities in the cortex. The role of inhibitory neurons in the providing of analytical and synthetic activity. The plasticity of the cortex (E.A.Asratyan). Cortico-subcortical and cortical-visceral relationship (K.M.Bykov). Pairing in the activity of the cerebral cortex. The functional asymmetry of the hemispheres in humans.

The autonomic nervous system. Structural and functional features of somatic and autonomic nervous systems. Sympathetic, parasympathetic, and metasympathetic departments of ANS. Principles of the organization of afferent and efferent autonomic reflexes pathways. Autonomic ganglia. Their functions. Preganglionic and postganglionic nerve fibers and their functional differences (J. Lengli). Mechanisms for the transfer of excitation in the autonomic ganglia. Mediators of ANS. The main types of receptive substances (adrenergic, cholinergic, etc) and tropic to the autonomic nervous system, and synaptic active substances. Effect of sympathetic, parasympathetic, and metasympathetic departments on organs innervation. The synergy and relative antagonism of their influence. Autonomic centers. The role of the hypothalamus, cerebellum, limbic system, reticular formation and the cerebral cortex in the regulation of autonomic functions. Vegetative components of behavior.

Physiology of the endocrine glands

Structural and functional organization of the endocrine system. Endocrine gland, diffuse endocrine system. Organisation, isolation, transport and decay of hormones. The main mechanisms of action of hormones. Self-regulation of the endocrine system. Communication of endocrine glands and nervous system. Tele- and parahormonal regulation of functions. Methods for endocrine glands studying.

Hypothalamic-pituitary system. Neurosecretion of hypothalamus: liberins and statins. Functional communications of the hypothalamus to the pituitary gland. Pituitary. Hormones of neurohypophysis.

Thyroid. Thyroid hormones and their role in the regulation of metabolism and organism growth. Calcitonin, its role in the regulation of calcium and phosphorus. Regulation of activity of the thyroid gland.

Parathyroid gland. Its role in the regulation of calcium and phosphorus.

Endocrine function of pancreatic gland. Its role in the regulation of metabolism of carbohydrate, protein and lipid. Regulation of the endocrine function of the pancreas.

The adrenal glands. The hormones of the adrenal cortex, their role in the regulation of metabolism and body functions. The functions of the adrenal medulla. Regulation of adrenal function.

Gonads. Male and female sex hormones and their role in the regulation of metabolism and body functions. Sexual cycles. The endocrine function of the placenta. Regulation of the endocrine function of sexual glands.

Epiphysis. Hormones, their role in the regulation of body functions (biological clock, etc).

The thymus gland and its function.

Hormones of gastrointestinal system. Tissue hormones. Regulatory peptides.

II. SYSTEMS PHYSIOLOGY

The concept of the internal environment of the organism (blood, lymph, extravascular fluid). Laboratory and clinical methods of research of blood and lymph.

Physiology of the blood

Blood. The concept of the blood system (G.F.Lang). Main functions of blood. Clinical blood tests. The composition and quantity of human blood.

Plasma and its composition. Hematocrit. The basic physiological constants of the blood and mechanisms of their regulation. Osmotic and oncotic pressure. The functional system maintaining constancy of the osmotic and acid-base status of the blood.

Erythrocytes. The structure, amount, calculation methods, functions of erytrocytes. Hemoglobin, structure, properties and quantity of hemoglobin. Compounds of hemoglobin. The color indicator of blood. Erythrocyte sedimentation rate (ESR) and the factors influencing it. The concept erythron. Hemolysis, its types. Polycythemia, the conditions and mechanisms of its development. Nervous and humoral regulation of erythropoiesis.

Leukocytes, types, number, counting techniques. The concept of leukocytosis and leukopenia. White blood cells count. The function of different types of white blood cells. Leukocytosis, conditions and mechanisms of its development. Nervous and humoral regulation of leukopoiesis.

Immunity. Immune response. Regulation of immunity. Immunity as the regulatory system.

Platelets, their structure, number and functions.

Hemostasis. The process of blood coagulation (A.A.Shmidt). Its significance. Modern ideas about the main factors involved in blood coagulation (tissue, plasma, platelet, erythrocyte, leukocyte clotting factors). The phases of blood clotting. Fibrinolysis. The role of vascular wall in the regulation of blood clotting and fibrinolysis. Coagulation, anticoagulant and fibrinolytic systems of blood as the main apparatus maintaining its liquid state. The concept oa regulating of blood aggregation state. Factors that accelerate and slow down blood clotting. The regulation of hemostasis. Age-related changes in the hemostatic system.

Blood Groups (ABO system, Rhesus affiliation, etc). Rules of blood transfusion. Blood-substituting solutions.

The physiology of the circulatory system

Morphological and functional characteristics of blood and lymph circulation. The role and place in maintaining of the vital functions of the organism.

The heart. The physiological properties of the myocardium and their characteristics (excitability, conductivity, contractility). Heart automatism. The conductive system of the heart, its functional characteristics. Cardiac cycle and its phases. The systolic and minute volume, cardiac index. The external manifestation of cardiac activity (electrical, acoustic, mechanical), their origin, and research methods (electrocardiography, phonocardiography, ultrasound echocardiography, invasive methods of investigation of myocardial contractility, and others.). The endocrine function. Regulation of cardiac activity (myogenic, humoral, nervous).

Systemic circulation. Functional classification of the blood and lymph vessels. The basic laws of hemodynamics. Total peripheral resistance of blood vessels. The mechanism of formation of vascular tone. Factors that ensure blood flow through high and low pressure vessels. The speed of movement of blood and lymph in different departments. Time of complete circulation of blood. Blood pressure, its types (systolic, diastolic, pulse, mean, central and peripheral, arterial and venous). Factors determining the magnitude of blood pressure. Blood pressure, linear and volume velocity of blood flow in various parts of the circulatory system. Methods of measuring pressure in the experiment and clinic (direct, Riva-Rocchi, I.S. Korotkov, arterial oscillography, measurement of venous pressure). Arterial pulse and its basic parameters, registration and evaluation. Venous pulse, phlebogram and its analysis.

Blood circulation in organs. Circulation in the myocardium, characteristics of blood circulation in the brain, lungs and other organs. Functional features of organ arterial and venous vessels, their central and local regulation. Organs as a blood depot. A change in the organ circulation in the muscular load, eating, pregnancy, hypoxia, stress and other conditions. Methods of studying of the organ circulation (occlusion plethysmography, ultrasound and electromag-

netic fluometry).

Microcirculation. Morpho-functional characteristics of the main components of the microcirculatory stream. The concept of a tissue functional element (A.M. Chernuh). Capillary blood flow and its features. Pre- and postcapillary resistance, blood pressure in capillaries of different organs, transcapillary filtration and factors affecting it. Microcirculation and its role in the mechanism of fluid and substance exchange between blood and tissues. Correlation between circulation and systemic blood flow.

Lymphatic system, its structure and functions. Lymphogenesis and mechanisms of its regulation. Factors that provide lymph flow and mechanisms for its regulation. Methods of studying of microcirculation.

Lymph, its composition, quantity, function, physiological significance. Extra-vascular liquid media of the body (interstitial, spinal, synovial, pleural, peritoneal, liquid environment of the eyeball, mucus), their role in providing vital activity of the cells of the body.

Functional system for maintaining blood pressure and organ blood flow. Blood circulation as a vegetative component of the body activity. Physiological prerequisites for disordes of the blood pressure level. Factors of a healthy lifestyle, preventing the disorders of the circulatory system.

Physiology of the respiratory system

The importance of breathing for the organism. The main stages of the breathing process. Respiratory cycle. Physiology of the respiratory tract. Regulation of their clearance. The value of ciliated epithelium. Ventilation of the lungs (minute, alveolar), its unevenness in different parts of the organ.

The mechanism of inhalation and exhalation. Pressure in the pleural cavity, change during breathing. Elastic properties of the lungs and chest walls. Surface active (surfactant) and tissue factors. Methods for studying external respiration (spirometry, spirography, pneumotachography).

Gas exchange in the lungs. Composition of inhaled, exhaled and alveolar air. Methods of determination. Relative constancy of the composition of the alveolar air. Pressure of gases dissolved in blood, measurement methods. The partial pressure of gases (O2, CO2) in the alveolar air. Properties of the pulmonary membrane. Diffuse ability. The ratio between the blood flow and ventilation. Non-respiratory function of the lungs.

Transport of gases by blood. Factors affecting the formation and dissociation of oxyhemoglobin. The content of O2 and CO2 in the arterial and venous blood. Oxymometry. Oxygen capacity of blood. O2 utilization rate in different conditions. Formation and dissociation of bicarbonates and carbogemoglobin. The value of carbonic anhydrase. Gas exchange between blood and tissues. Voltage of O2 and CO2 in the tissue fluid and cells.

Regulation of respiration. CNS structures providing respiratory periodicals. Receptors of the lungs (stretching, irrational, juxta-alveolar), their role. Reflexes of Goering and Breuer. Reflexes to irritation of the respiratory muscles, their importance in compensating respiratory loads. The importance of the hypothalamus, the limbic system and the cortex of the cerebral hemispheres. Conditionally reflex and voluntary regulation of respiration. Effect on the frequency and depth of breathing gas composition and pH of arterial blood. Central and peripheral chemoreceptors. Change in ventilation of the lungs with hypercapnia and hypoxia. Breathing during physical work, with increased and reduced pressure. Backup features. Protective respiratory reflexes. Breath at speech. Functional system for maintaining the constancy of the gas composition of the blood.

Physiology of the digestive system

Food motivation. The physiological basis of hunger and satiety. The notion of I.P. Pavlov about the food center. Functional system that maintains the consistency of nutrients in the blood. Types of digestion (intracellular, cavitary, membrane), the main stages. The digestive conveyor, its functions (secretion, motor, absobtion). Basic principles and mechanisms of the regulation of digestion. Phases of secretion of the main digestive glands. Non-digestive functions of the digestive system. Endocrine function, effects of gastrointestinal hormones. Increment of digestive enzymes. The immune system of the digestive tract. Methods of studying of the functions of the digestive tract. I.P. Pavlov as the creator of the chronic experimental methods of research of digestion

Digestion in the oral cavity. Mechanical and chemical processing of food. Chewing, its peculiarity in connection with the type of food. Regulation of chewing. Salivation. The amount, composition and properties of saliva. Significance in digestion. Regulation of salivation. Swallowing, its phase, regulation.

Digestion in the stomach, its role in the digestive conveyor. Secretory activity of the stomach. Composition and properties of gastric juice. Regulation of secretion of the gastric glands. Adaptive changes in gastric secretion. Motor and evacuation activity of the stomach, its regulation.

Digestion in the small intestine. Duodenum. Composition and properties of the pancreatic juice, mechanisms for adapting its secretion. Regulation of pancreatic secretion. The liver, its functions. Composition and properties of bile, a value in digestion. Bile formation and bile secretion, regulation. Intestinal secretion. The composition of the intestinal secretion. Regulation of intestinal secretion. Cavity and membrane (A.M. Ugolev) hydrolysis of nutrients. Motor activity of the small intestine. Regulation, the value for digestion.

Digestion in the large intestine. The importance of microflora and gas in the intestine. Motility of the colon. Defecation.

Absorbtion. Absorption of various substances in the digestive tract, mechanisms. Regulation. Methods of studying.

Metabolism and energy. Nutrition

Exchange of substances between the organism and the environment as the main condition of life and preservation of homeostasis. The plastic and energy role of nutrients. The concept of the exchange and specific synthesis in the body of fats, carbohydrates, proteins. Nitrogen balance. Positive and negative balance. Regulation of the exchange of nutrients in the body.

The importance of minerals and trace elements, the need for them, the value of water for the body. Factors determining its distribution in the body. Water and mineral exchange at work in hot manufacture.

Vitamins, the role of basic groups. Energy balance of the body. Caloric and physiological value of various nutrients. Direct and indirect calorimetry (complete and incomplete gas analysis). Caloric equivalent of oxygen. Respiratory coefficient. The basal metabolism, magnitude, its determinants. Specific-dynamic action of nutrients. Working exchange. Energy costs of the organism for different types of work. Age features of metabolism.

Physiological basis of rational nutrition. The theory of balanced and adequate nutrition. Types of clinical nutrition. The norm of nutrition, the dependence on age, types of work and the state of the organism.

Thermoregulation

Temperature constancy of the internal environment of the body as a necessary condition for the normal course of metabolic processes. Poikilo-, homoyo- and heterothermia. Body temperature, its daily fluctuations. Temperature of various parts of the skin and internal organs of human. Physical and chemical thermoregulation. Metabolism as a source of heat generation. The role of individual organs. Heat transfer. Ways to release heat from the surface (radiation, conducting, evaporation). Physiological mechanisms of heat transfer (blood flow in skin vessels, sweating, etc.). Peripheral and central mechanisms of thermoregulation. Thermoreceptors. Center of thermoregulation. Nervous and humoral mechanisms. Functional system that maintains temperature constancy of the internal environment during changes of external temperature.

Physiology of the excretion system

The organs of excretion (kidneys, skin, lungs, digestive tract), their participation in maintaining of the body's homeostasis.

Kidney. Nephron as a morphofunctional unit of the kidney. Blood circulation in the kidney, its regulation. The main processes of urine formation (glomerular filtration, tubular reabsorption and secretion). Mechanisms of filtration, composition of primary urine. Countercurrent system. Reabsorption in tubules and its regulation. Secretory processes in tubules. The final urine, its composition. Neurohumoral regulation of urination (ADH, aldosterone, catecholamines, etc.). The role of the kidneys in maintaining nitrogen balance, osmotic pressure, pH, blood volume. Non-excretory functions of the kidneys. Adaptive changes in kidney function under different conditions.

Functions of the pelvicalyceal system, ureters, bladder, urethra. Reflex regulation of urination. Clinical and physiological methods for the study of kidney function. Age changes in urination.

Skin. Skin as a secretory organ. Functions of the sebaceous and sweat glands, regulation of their activity. Non-excretory functions of the skin (barrier, protective, thermoregulatory, etc.).

Analyzers (sensory systems)

The concept of sense organs, analyzers, sensory systems. The teaching of I.P. Pavlov of analyzers. Their importance in the cognition of the world. Systemic nature of perception. The role of different types of afferentation: the situational, starting and reverse in the process of cognition. Functional organization of analyzers. Peripheral department (receptors). The conductor department. Mono- and polymodal neurons. Processes of higher cortical analysis and synthesis of afferent excitations. Interaction of analyzers. The Weber-Fechner law. Coding information in different departments. Holographic principle in explaining the mechanisms of perception. Regulation of the analyzers. Adaptation. Methods of research of analyzers.

Vision. Receptor apparatus. Photochemical processes in retinal receptors under the action of light. Functions of bipolar and ganglion cells of the retina. Theories of color vision (M.V. Lomonosov, G. Helmholtz, P.P. Lazarev). Modern ideas about the perception of color. The main forms of disorder of color perception. Line of sight. Visual acuity. Refraction and accommodation. Conductor and cortical departments. Information processing at different levels. Formation of the visual image. The role of the right and left hemispheres in visual perception.

The auditory analyzer. Sound-collecting, sound-conducting and sound-receiving apparatus. Conductive and cortical parts of analyzers. The central mechanisms of the analysis of sounds. Theories of the perception of sounds (G. Helmholtz, G. Bekesi and others). Binaural hearing.

Vestibular analyzer. Role in assessing of body position in space and its moving. Receptor, conductive and cortical departments. Characteristics of the vestibular analyzer during acceleration and in a state of weightlessness. Training of the vestibular apparatus.

Motor analyzer. Role in perception and assessment of the position of the body in space. Receptor, conductive and cortical parts of the analyzer.

Tactile analyzer. Role in perception of touch, pressure and vibration. Receptor, conductive and cortical departments.

Olfactory analyzer. Receptor, conductive and cortical parts of the analyzer. Classification of gustatory sensations.

The taste analyzer. Receptor, conductive and cortical parts of the analyzer. Classification of gustatory sensa-

tions.

Interoceptive analyzer. Its role in homeostasis maintaining. Receptor, conductive and cortical parts of the analyzer.

Nociception. The biological significance of pain, projection and reflectin of pain. Areas of Zakharyin-Ged. Modern ideas about nociceptive and antinociceptive systems. General idea of anesthesia.

Biologically active points and the principle of reflexotherapy.

III. INTEGRATED ACTIVITY OF THE ORGANISM

Biological basis of behavior

Congenital forms of behavior (unconditioned reflexes and instincts), their significance for the adaptive activity of the organism. Achievements of ethology in the study of innate forms of behavior. Motivation.

Higher nervous activity

The importance of the doctrine of higher nervous activity for the theory and practice medicine, pedagogy, psychology and philosophy. Objective methods of study. Conditional reflex as a form of adaptation to changing conditions. The regularity of formation and manifestation of conditioned reflexes. Their classification. Physiological mechanisms of formation of conditioned reflexes. Their structural and functional basis. Deceleration of the conditioned reflex. Types of cortical inhibition. Modern ideas about the mechanisms of cortical inhibition. Analytic and synthetical activity of the cerebral cortex. Dynamic stereotype, its essence, importance for the acquisition of work skills. The architecture of a holistic behavioral act (P.K. Anokhin).

Types of higher nervous activity of animals and humans (I.P. Pavlov), classification, characteristics, methods of defenition. The role of upbringing. Characteristics of the higher nervous activity of human and its difference from the higher nervous activity of animals. The concept of I.P. Pavlov of the first and second signaling systems.

Emotions, their biological role. Classification. The theory of emotions. The role of various brain structures in the formation of emotional states. Vegetative and motor components of emotions.

Waking. Sleeping, its types and phases. Theories of sleep (I.P. Pavlov, V. Hess, PK Anokhin, etc.). Dreaming. Physiological basis of hypnotic states.

Physiological basis of human mental functions

Characteristics of human mental functions (attention, perception, memory, emotion, thinking, conscience, speech). Adaptive role. Personality characteristics (ability, typological characteristics, temperament, character, attitudes, motivation directions). The ignificance of the functional state of the central nervous system for the implementation of mental functions. Physiological methods of studies of mental functions.

1. Warning. The ыignificance of the work of Pavlov and Ukhtomski for understanding the physiological mechanisms of attention. The role of inhibition in the concentration of attention. Physiological correlates of attention.

2. Memory, its types and mechanisms.

Emotions and motivation. Emotions as physiological and psychological state. The significance of emotions in the purposeful activity of human. Emotional stress and its role in the development of neuroses, hypertensive states and other psychosomatic diseases.

Thinking. The development of abstract thinking in humans. The figurative and verbal thinking. Role of brain structures in thinking. Physiological approaches to the study of the thinking process.

Consciousness. The role of the doctrine of higher nervous activity in the formation of dialectical and materialist approach to the problem of consciousness. The subconscious and superconscious.

Speech. Functions of speech. The functional asymmetry of the cerebral cortex associated with the development of speech in humans. Physiological methodology of speech research in humans. Biomechanics of formation of speech sounds. The suggestion, self-suggestio, psychotherapy.

Purposeful behavior

Purposeful behavior as a form of behavior that leads to the achievement of the organism adaptive result. Types of purposeful behavior and characteristics of their goal-setting apparatus. Biologically deterministic types of goal-directed behavior (food, defensive, sexual, etc.). Socially determined behaviors (work activity, training, collective work, etc.).

Physiological basis of labor activity. Labor as a purposeful human activity. Features of the autonomic functions of the body changes in different types of labor activity. Effect of physical work on strength, endurance, performance. Physical exercise and its impact on operability. Characteristics of physical and mental work. The nerve, autonomic and endocrine components. The role of emotions. Characteristics of work in the conditions of modern manufacturing (hypokinesia, local load, monotony of work, emotional stress). Dynamic of operability during the working day, the working week. Methods of assessing of the operability changes.

The problem of fatigue of the whole organism. Sechenov's theories of fatigue and their confirmation of the data of modern physiology. Factors contributing to the development of fatigue. Tiredness as a subjective expression of fatigue process. Active rest time (Sechenov) and its mechanisms.

Different recovery rate of different systems of the organism in the process of relaxation. Rest periods: the res-

toration and consolidation of the recovery. Optimum modes of activity and rest as the basis for long-term high efficiency of the organism. Methods for assessing the level of functioning and functional reserve of various systems of the human organism. Valuation techniques level of functioning and functional reserve of different human body systems. The problem of predicting the physical and mental capacities of human for work, sports.

Adaptation of the organism to various conditions of existence

Biorhythmology (chronobiology). The idea of the discreteness of various processes in the human organism. Oscillatory character of constants, reactions and cycles in connection with external conditions. Classification of biorhythms. Supposed mechanisms of perception of external rhythm generators, the role of the epiphysis, the suprachiasmatic nucleus of the hypothalamus, the interaction of hormones. Subjective perception of time. Free flowing and unbound time. Social rhythm generators. Stereotypes of human life.

Physiology of adaptation. Its Definition. Individual adaptation of the body. Biological and social factors underlying adaptation. Types, phases and adaptation criteria. Adaptation of avoidance, passive and active type of adaptation. Mechanisms of development of adaptive reactions. Resistance. The concept of cross-resistance and sensitization. Specific adaptive changes in the body to a number of factors (increased muscular activity, hypodynamia, etc.). Displaced modes of life. Transmeridian movements. Training regimes. The concept of the biosphere and noosphere. Ecology of human. Social aspect of adaptation.

Organism and its protective systems

Factors that ensure the integrity of the body. Barriers to the external and internal environment of the organism (skin, mucous membranes, cell membranes, histohematological and blood-brain barrier). Their physicochemical and physiological properties. Protective role of mucus.

Immunity, its types. Immunocompetent cells, their cooperation in the immune response. Neuro-humoral regulation of the immune response. Immunity as a regulatory system. Immune systems of various organs.

Protective reflexes. Protective behavior of animals and humans. Functional system for ensuring the integrity of body tissues.

Reproduction

Stages of reproduction (puberty, the formation and implementation of sexual motivation, fertilization, pregnancy, childbirth, breastfeeding and upbringing). Anatomical and physiological bases of reproduction. Regulation of sexual functions. Unconditional-reflex mechanisms (afferent, central and efferent links). Erogenous zones, erection, ejaculation, orgasm, their characteristics in women and men. Conditional-reflex regulation. Neurohumoral regulation (hormones of the hypothalamus, pituitary gland and sex hormones). Formation and mechanisms of sexual motivation. The role of sex hormones in the formation of sexual behavior. The phases of the sexual cycle in men (libido, erectile, copulatory and ejaculatory phases, refractory phase). Characteristics of the phases of the sexual cycle in women. The role of social factors in the implementation of sexual functions. Physiological patterns of pregnancy and childbirth.

5. Educational technologies

The complex of modern educational technologies used in the teaching of the discipline "Normal Physiology" is focused on individualization and variability of the educational process, academic mobility of trainees, regardless of age and basic level of knowledge.

Teaching discipline is based on the application of the following types of educational technologies:

1. Lectures with use of multimedia technologies;
2. Practical works with use of video films and computer simulations;
3. Conducting seminars in the form of group discussions and case studies;
4. The solution of situational problems;
5. Conducting colloquiums;
6. Conducting testing on the sections of the discipline;
7. Computer testing.
8. The solution of situational problems.
9. Independent work with literature.
10. Execution of coursework.

5.1. Active methods of education

Solution of situational problems

3rd semester

Physiology of excitable tissues. Physiology of the central nervous system. Regulation of physiological functions. The physiology of endocrine glands. Human life activity under various types of ac-

tivity.

4rd semester

Physiology of the blood system. The physiology of the circulatory system. Physiology of the respiratory system. Physiology of the digestive system. Metabolism and energy. Food. Thermoregulation. Physiology of the excretory system. Physiology of the reproductive system.

5.2. Educational technologies for people with disabilities and disabled people

For the realization of the individual approach to training students carrying out educational process on their own trajectory within the individual working plan, studying of this discipline is based on the following opportunities: ensuring out-of-class work with students including electronic educational environment with the use of the proper program equipment, Internet resources, individual consultations etc.

6. Educationaland methodological support of students' out-of-class work. Assessment means for current progress monitoring, interim attestation of subject mastering results

6.1. Outline of students' individual work

No. week	Topic	Type of individual work	Task	Suggested reading material	Hours
III семестр					
1	Basic concepts of physiology. Physio-logical methods of investigation of excitable tissues.	Preparation for the classes, preparation for the exam	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	1
2	Modern ideas about the mechanisms of origin of the rest potential and the action potential	Preparation for the classes, preparation for the exam	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	2
3	Modern ideas about the mechanism of muscle contraction	Preparation for the classes, preparation for the exam	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	2
4	Final lesson	Preparation for the classes, preparation for the exam	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	1
5	General physiology of the central nervous system. Analysis of the reflex arc.	Preparation for the classes, preparation for the exam	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	2
6	Coordination of reflex activity	Preparation for the classes, preparation	To study the theoretical material on the topic of the lesson.	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media,	2

No. week	Topic	Type of individual work	Task	Suggested reading material	Hours
		for the exam	To answer the questions for self-monitoring in guidelines	2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	
7	Final lesson	Preparation for the classes, preparation for the exam	To study the theoretical material on the topic of the lesson. To answer questions for self-monitoring in guidelines To anwer the questions on the topic of the section.	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	1
8	Physiology of the central nervous system	Preparation for the classes, preparation for the exam, preparation of course work.	To study the theoretical material of the section. To answer the questions for the control lesson.	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	2
9	The autonomic nervous system	Preparation for the classes, preparation for the exam, preparation of course work.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	2
10	Physiology of the glands of internal secretion.	Preparation for the classes, preparation for the exam, preparation of course work.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	2
11	Final lesson	Preparation for the classes, preparation for the exam	To study the theoretical material of the section. To answer the questions for the control lesson. To answer the test questions on the topic of the section	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	1
12	Physiology of sensory systems	Preparation for the classes, preparation for the exam, preparation of course work.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.:	2

No. week	Topic	Type of individual work	Task	Suggested reading material	Hours
				Litterra, 2015. - 768 p.	
13	Visual and auditory analyzers.	Preparation for the classes, preparation for the exam, preparation of course work.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	2
14	Vestibular, olfactory, taste analyzers. Nociception.	Preparation for the classes, preparation for the exam, preparation of course work.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	2
15	Physiology of higher nervous activity	Preparation for the classes, preparation for the exam, preparation of course work.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	2
16	Behavior, mind, learning, memory, emotions.	Preparation for the classes, preparation for the exam, preparation of course work.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	2
17	Sleeping, its kinds. Individuality of a person	Preparation for the classes, preparation for the exam	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	1
18	Final lesson	Preparation for the classes, preparation for the exam, preparation of course work.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	2
19	Test session	Preparation for the protection of course	To study the theoretical material on the topic of course work	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media,	1

No. week	Topic	Type of individual work	Task	Suggested reading material	Hours
		work		2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	
IV семестр					
1	Physiology of the blood system. Physiology of erythrocytes.	Preparation for the classes.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	2,5
2	Physiology of leukocytes.	Preparation for the classes.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	2,5
3	Physicochemical properties of blood. Blood groups.	Preparation for the classes	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	2,5
4	Physiology of blood clotting.	Preparation for the classes.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	1
5	The final lesson on the section "Blood".	Preparation for the classes, preparation for the exam.	To study the theoretical material on the topic of the lesson. To answer questions for self-monitoring in guidelines To answer the test questions on the topic of the section.	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	3
6	Regulation of cardiac work	Preparation for the classes.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et	2,5

No. week	Topic	Type of individual work	Task	Suggested reading material	Hours
				al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	
7	Microcirculation.	Preparation for the classes.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	2,5
8	Systemic circulation.	Preparation for the classes.	To study the theoretical material on the topic of the lesson. To answer questions for self-monitoring in guidelines To fill in the workbook on the topic of classes.	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	2,5
9	The final lesson on the section "Circu-lation".	Preparation for the classes, preparation for the exam.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	3
10	Physiology of the respiratory system	Preparation for the classes, preparation for the exam.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines To study the anatomical formations on the topic of the lesson.	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	2,5
11	Regulation of respiration.	Preparation for the classes.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	2,5
12	Final lesson	Preparation for the classes, preparation for the exam.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines To answer the test questions on the topic of the lesson	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	3

No. week	Topic	Type of individual work	Task	Suggested reading material	Hours
13	Physiology of the digestive system.	Preparation for the classes, preparation for the exam.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	3
14	Metabolism and energy. Nutrition. Thermoregulation.	Preparation for the classes, preparation for the exam.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	2,5
15	Physiology of the excretory system.	Preparation for the classes.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	2,5
16	The final lesson on the sections "Digestion", " Excretion".	Preparation for the classes, preparation for the exam.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines To answer the test questions on the topic of the lesson.	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	3
17	Physiology of reproductive function.	Preparation for the classes.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	2,5
18	Physiological basis of human work activity	Preparation for the classes.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in guidelines	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p. Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	2,5
19	Adaptive and compensatory mechanisms of the organism.	Preparation for the classes, preparation for the exam.	To study the theoretical material on the topic of the lesson. To answer the questions for self-monitoring in	Normal physiology: textbook / ed. B. I. Tkachenko. - 3rd ed., M.: GEOTAR-Media, 2014. - 688 p.	3

No. week	Topic	Type of individual work	Task	Suggested reading material	Hours
			guidelines	Normal physiology: textbook / L.Z. Tel [et al.]; Ed. L.Z. Telya, N.A. Aghajanyan. - M.: Litterra, 2015. - 768 p.	

6.2. Instructional guidelines on students' out-of-class work organization

Out-of-class work of students is conducted in accordance with the methodological recommendations of the Department of Human Physiology:

1. Mikulyak NI, Morozova MI, Anfinogenova OI Normal physiology. Methodical recommendations for practical classes for students of specialties "General Medicine" and "Pediatrics". Part 1. - Penza, 2017. - 71 p.
2. Mikulyak NI, Morozova MI, Anfinogenova OI Normal physiology. Methodical recommendations for practical classes for students of specialties "General Medicine" and "Pediatrics". Part 1. - Penza, 2017. - 71 p.

6.3. Materials to carry out current monitoring and interim attestation of students' knowledge

Control of development of competences

№	Type of assessment	Topics (parts) assessed	Competences and elements assessed
1.	Tests assessment	Section 1, 2, 3, 4, 5, 6, 7, 8, 9	GEC-1, GPC-9
2.	Assessment of practical skills	Section 1, 2, 3, 4, 5, 6, 7, 8, 9	GEC-1, GPC-9
3.	Discussion	Section 1, 2, 3, 4, 5, 6, 7, 8, 9	GEC-1, GPC-9
4.	Tutorial	Section 1, 2, 3, 4, 5, 6, 7, 8, 9	GEC-1, GPC-9
5.	Term paper	Section 1, 2, 3, 4	GEC-1, GPC-9

Examples of tests

1) The muscle tissue type that consists of single, very long, cylindrical, multinucleate cells with very obvious striations is:
A) skeletal muscle only
B) cardiac and smooth muscle
C) cardiac and skeletal muscle
D) cardiac muscle only
E) smooth muscle only

2) Which one of the following does NOT compress the abdomen:
A) rectus abdominis
B) internal oblique
C) latissimus dorsi
D) external oblique
E) transversus abdominis

3) Neurotransmitters are released upon stimulation from a nerve impulse by the:
A) thick filaments
B) motor unit
C) axon terminals of the motor neuron
D) sarcolemma of the muscle cell
E) myofibrils

4) What type of membrane wraps a fascicle:
A) perimysium
B) aponeuroses
C) tendons
D) epimysium
E) endomysium

5) Which one of the following muscles is involved in abduction of the arm at the shoulder joint:
A) biceps brachii
B) triceps brachii
C) deltoid
D) latissimus dorsi
E) pectoralis major

6) While doing ″jumping jacks″ during an exercise class, your arms and legs move laterally away from the midline of your body. This motion is called:
A) extension
B) adduction
C) circumduction
D) flexion
E) abduction

7) Which of the following muscles closes the jaw:
A) the frontalis
B) the masseter and the temporalis
C) the sternocleidomastoid
D) the masseter
E) the buccinator

8) An elaborate and specialized network of membranes in skeletal muscle cells that function in calcium storage is the:
A) sarcolemma
B) mitochondria
C) sarcoplasmic reticulum
D) myofibrillar network
E) intermediate filament network

9) A sarcomere is:
A) the area between two intercalated discs
B) the nonfunctional unit of skeletal muscle
C) the wavy lines on the cell, as seen in a microscope
D) the contractile unit between two Z discs
E) a compartment in a myofilament

10) A muscle located on the ventral (anterior) side of the body is the:
A) occipitalis
B) gluteus medius
C) gastrocnemius
D) latissimus dorsi
E) pectoralis major

11) Which of the following muscles is not involved in dorsiflexion and/or plantar flexion of the foot:
A) gastrocnemius
B) extensor digitorum longus
C) soleus
D) iliopsoas
E) tibialis anterior

12) During skeletal muscle contraction, myosin cross bridges attach to active sites of:
A) the H zone
B) Z discs
C) actin filaments
D) myosin filaments
E) thick filaments

13) The plasma membrane of a muscle cell is called the:
A) myofilament
B) sarcomere
C) sarcolemma
D) sarcoplasm
E) sarcoplasmic reticulum

14) The gap between the axon terminal of a motor neuron and the sarcolemma of a skeletal muscle cell is called the:
A) cross bridge
B) motor unit
C) neuromuscular junction

D) sarcomere
E) synaptic cleft

15) Which of these pathways to regenerate ATP during muscle activity is the fastest:
A) direct phosphorylation of ADP by creatine phosphate
B) aerobic respiration
C) both aerobic respiration and anaerobic glycolysis
D) oxidative phosphorylation
E) anaerobic glycolysis and lactic acid formation

16) Which of the following muscles inserts on the calcaneus:
A) the soleus
B) the iliopsoas
C) the tibialis anterior
D) the sartorius
E) the semitendinosus

17) A nursing infant develops a powerful sucking muscle that adults also use for whistling or blowing a trumpet called the:
A) zygomaticus
B) temporalis
C) masseter
D) buccinator
E) platysma

18) Anaerobic glycolysis occurs without:
A) glucose
B) oxygen
C) lactic acid
D) ATP
E) carbon dioxide

19) The type of muscle tissue pictured in Figure 6.3 is:
A) striated
B) found only in the heart
C) skeletal muscle
D) voluntary
E) smooth muscle

20) Paralysis of which of the following would make an individual unable to flex the thigh:
A) biceps femoris
B) vastus intermedius
C) vastus lateralis
D) vastus medialis
E) iliopsoas and rectus femoris

Criteria for assessing of the test

"Excellent" ("5") - 91% and more correct answers to questions.
"Good" ("4") - 81-90% of correct answers to questions.
"Satisfactory" ("3") - 71-80% of correct answers to questions.
"Unsatisfactory" ("2") - 70% and less correct answers to questions.

Sample questions for control sessions

Physiology of excitable tissues

1. Physiology as a subject, its importance for medicine and objectives. Relationship of physiology with other medical sciences. The role of physiology in human activity. Physiology and technology.

2. Methods of physiological studies and the history of their development (observation, registration of physiological processes, study of bioelectric phenomena, electrical stimulation and recording of non-electrical quantities, acute and chronic experiments).

3. History of the development of physiology. Physiological representations in the Ancient World, in the middle and 16th - 17th centuries.

4. Development of physiology in the 18-19th centuries.

5. Development of physiology in the 20 century. Nobel Prize laureates.

6. Physiology of the whole organism. Physiology and Cybernetics. Studying of higher nervous activity. Relationships between structure and function. Subcellular processes. Cell, membrane, tissues, organs, physiological and functional systems.

General properties of the central nervous system

1. Mechanisms of regulation of physiological processes. Humoral and nervous mechanisms, their features. Regulation of functions from the position of cybernetics. Negative and positive feedbacks, their importance in regulation.
2. Neural theory. The structure of neurons and their functional classification. Conducting of the action potential and local potentials. The role of neuroglia.
3. Reflex, reflex arc and ring. Mono- and polysynaptic reflexes.
4. Classification of receptors. Mechanisms of generation of action potential in the afferent nerve. The Weber-Fechner law. General properties of receptors.
5. Nerve fiber and its structure functions. The degeneration of the fiber after

Regulation of physiological functions

1. Humoral regulation of physiological functions. Classification of humoral agents and endocrine glands. Biochemical nature of hormones. The mechanism of their perception and action.
2. The main aspects of humoral influences. Regulation of hormone production. The contours of self-regulation, the principle of "plus-minus interaction." Methods of examination of endocrine glands.
3. Pituitary gland, its structure. The anterior lobe of pituitary gland and its hormones.
4. Intermediate and posterior lobes of the pituitary gland, their hormones.
5. Thyroid and parathyroid glands. Their hormones and regulation of activity.

Circulation

1. Functions of the cardiovascular system. Structure of circulatory system.
2. Movement of blood in the heart. Significance of cardiac valve.
3. The heart cycle and its phases.
4. Mechanical and sound manifestations of cardiac activity.
5. Morphological characteristics of the heart muscle.
6. 6. Functional characteristics of the myocardium

Digestion

1. Digestion. Functions of the digestive system and classification of digestive processes. Principles of the regulation of digestion. The food center, the motivation for hunger and satiety. Innervation of the gastrointestinal tract.
2. The role of the nervous and humoral mechanisms of the regulation of digestion. Own hormones of the gastrointestinal tract and their characteristics. Phases of secretion of the digestive glands. Start-up effects on the gastrointestinal tract. Methods of studying the function of the digestive tract.
3. Digestion in the mouth. Salivary glands and methods for their study. Regulation of salivation. Swallowing.
4. Digestion in the stomach and methods of its study in animals and humans. The structure and innervation of the glands of the stomach. Composition of gastric juice. Curves of secretion for different foods. Regulation of gastric secretion, the phase of secretion and their mechanisms. Own hormones of the stomach.
5. Digestion in the duodenum. Methods of research.

Excretion

1. Excretion system and renal function. Methods of studying of the kidneys.
2. Structure and blood supply of the nephron. Yuxtaglomerular complex.
3. The theory of urination. The mechanism of glomerular filtration. Composition of primary urine.
4. Proximal reabsorption and its mechanisms.
5. Functions of the proximal tubule and the loop of Henle. Intensity of proximal reabsorption. Dilution and concentration of urine.
6. Distal (regulating) reabsorption. Its displacement in hydremia and water deficiency. Mechanisms of sodium reabsorption.
7. The involvement of the kidneys in the regulation of homeostasis: water exchange, osmotic pressure, pH, Isoionium, blood pressure, erythropoiesis. Excretory, secretory and metabolic functions of the kidneys

Blood System

1. The concept of the blood system. The ratio of plasma and formed elements. Composition of blood.
2. Morphological characteristica of erythrocytes. Regulation of erythropoiesis.
3. The structure of hemoglobin. Quantification of the amount of hemoglobin in the blood. Color indicator.
4. Characteristics of leukocytes. Leukogram and its meaning.
5. Quantification of leukocytes in the blood.

Human life activity under various types of activity

1. Higher and lower nervous activity (I.M. Sechenov, I.P. Pavlov). Conditioned and unconditioned reflexes. Their similarities and differences. Classification of unconditioned and conditioned reflexes, their components. Signals of conditioned reflexes.
2. Principles of conditioned reflex activity of the cortex. The mechanisms and conditions for the formation of conditioned reflexes.
3. The mechanism of formation of conditioned reflexes (I.P. Pavlov, Gasto, Yoshii). Scheme of the conditioned reflex arc.
4. The biological nature of conditioned reflexes. Theory of convergent closure of temporary bonds by P.K. Anokhin. Conditional reflexes of the second and third orders.
5. Modern ideas about the mechanisms of memory. Types of memory. Physical and biochemical theory of memory.

Respiration

1. Respiration system, its importance for the organism. The main stages of the breathing. Functional system for maintaining the consistency of the gas composition of the blood.
2. Respiratory cycle. Physiology of the respiratory tract. Regulation of their clearance. The significance of ciliated epithelium.
3. External breathing. The mechanism of a calm and deep inhale and exhale. Pressure in the pleural cavity, its change during breathing. The Donders scheme.
4. Dynamic and static resistance to breathing. Elastic properties of the lungs and chest wall. Surfactant and its meaning.
5. Ventilation of the lungs, its unevenness in different parts of the organism. Alveolar and pulmonary ventilation. Spirometry and spirography.

Criteria for assessing the interview in control sessions

"Excellent" - the answer is complete, correct and logical; Proficiency in medical terminology; The answers to the additional questions are clear and short.

"Good" - the answer is not logical enough with single errors in details; Single errors in medical terminology; The answers to additional questions are correct, but not clear enough.

"Satisfactory" - the answer is not correct enough, incomplete, with errors in details; Errors in medical terminology; The answers to additional questions are not clear enough, with errors in details.

"Unsatisfactory" - the answer is incorrect, incomplete, with gross mistakes; Ignorance of medical terminology; Answers to additional questions are incorrect.

Exemplary questions of practical skills

Physiology of excitable tissues

1. Study of a neuromuscular comlex
2. Study of devices for irritation
3. Oscillographic recording of the action potentials
4. The first and second experiments of Galvani
5. Identification of fatigue

Physiology of the central nervous system

1. Study of the segmental structure of spinal reflexes.
2. Analysis of the reflex arc.
3. Summation of excitation in the spinal cord
4. The study of Sechenov's inhibition
5. Study of the conjugate inhibition of spinal reflexes (the Danilevsky experiment)
6. Study of irradiation of excitation in the spinal cord.

System of the blood

1. Counting of red blood cells.
2. Determination of hemoglobin according to Sali.
3. Determination of hematocrit.
4. Study of changes in the number of leukocytes after exercise stress.
5. Study of the leukocyte formula
6. Determination of osmotic resistance of erythrocytes.

Circulation

1. Finding a apex beat in humans.
2. Listening to heart tones and their audio recordings.
3. Determination of the duration of the cardiac cycle.

4. Studying of the work of the heart at different temperatures.
5. Studying of the effect on the heart of Ca and K ions.
6. Ligature of Stannius.
7. Observation of the contraction of isolated mouse heart.
8. ECG recording in three leads.

Respiration

1. Measurement of the vital capacity of the lungs with a spirometer.
2. Spirography and analysis of spirograms (the following indicators are determined: TLC, TV, RV, ERV, IRV, IC, IVC, VC, Vt, breath holding on inhaling and exhaling).
3. Calculating of the MVV and IRV.
4. Calculation of pulmonary capacities and functional parameters of ventilation according to tables, formulas and nomograms.

1. Study of protein digestion by gastric juice.
2. Study of the movement of the cilia of the frog's esophagus.
3. Calculating of energy consumption using a spirograph.
4. Calculating of sweating in humans (Minor's methods).

Human life activity during different types of activity

1. Definition of visual acuity.
2. Definition of the field of view.
3. Finding a blind spot (the experiment of Mariott).
4. Research of color vision according to the tables of Rabkin.
5. Definition of pupillary reflex
6. Definition of the sensitivity of the kinesthetic analyzer (The subject with closed eyes compares the mass of the glasses with the sand and arranges them in order of increasing their mass).
7. Definition of the accuracy of the kinesthetic analyzer
8. Definition of acuity of hearing.

Criteria for assessing of practical skills

"Excellent" ("5") - 91% and more correct answers.
"Good" ("4") - 81-90% of correct answers.
"Satisfactory" ("3") - 71-80% of correct answers.
"Unsatisfactory" ("2") - 70% and less correct answers to the questions.

Sample examination questions

General issues

1. Normal physiology as a subject, its tasks and importance for medicine. Relationship of physiology with other sciences. The role of physiology in human activity.
2. Methods of physiological studies and the history of their development (observation, acute and chronic experiments, registration of physiological processes).
3. Methods of physiological studies and the history of their development (study of bioelectric phenomena, electrical recording of non-electrical quantities, electrical stimulation of organs and tissues).
4. Physiology of the organism. Physiology and Cybernetics, Mathematics and Informatics in Physiology. Methods of studying of higher nervous activity.
5. Representations about physiology in the ancient world, in the middle ages, in the 17-19th centuries.

Physiology of excitable tissues

1. Bio-currents. Experiments of Galvani and Dubois-Reymond. Rest potential and its nature. Membrane-ion theory of Bernstein. Conditions and causes of polarization of the membrane.
2. Structure of cell membranes and electrolyte composition of the cytoplasm, their role in the genesis of the membrane potential. Sodium-potassium pump. Ionic channels of membranes.
3. Action potential, history of discovery (Matteuchi, Mueller, Kelliker, Dubois-Reymond). Methods of registration of the action potential. Ionic mechanism of the action potential.
4. Ionic nature of the action potential. The theory of Bernstein and Hodgkin. Ionic channels. The magnitude of the action potential in different tissues.
5. Change in membrane potential under the action of subthreshold stimuli. Local responses. The level of critical depolarization and the depolarization threshold. Change in ionic conductivity in the generation of the action potential.

Physiology of the central nervous system

1. Spinal cord, its structure and functions. Characteristics of spinal neurons. Metamerism of the spinal cord. Types of spinal reflexes and their properties.
2. Pathways of the spinal cord. Reflexes of the spinal cord, their types and the structure of reflex arcs. Descending control of the spinal cord. Spinal shock and its mechanisms.
3. Medulla oblongata, its neural organization. Involvement of the neurons of the hindbrain in the processes of self-regulation of functions.
4. The midbrain, its structure and functions. Decerebral rigidity and mechanisms of its occurrence.

Regulation of physiological functions

1. Humoral regulation of physiological functions. Classification of humoral agents and endocrine glands. Biochemical nature of hormones. The mechanism of their perception and action.
2. The main aspects of humoral influences. Regulation of hormone production. Contours of self-regulation, the principle of "plus-minus interaction". Methods of examination of endocrine glands.
3. Pituitary gland, its structure. The anterior pituitary gland and its hormones.
4. Intermediate and posterior lobes of the pituitary gland, their hormones.
5. Thyroid and parathyroid glands. Their hormones and regulation of activity.

Circulation

1. Functions of the cardiovascular system. Circulation circles.
2. Movement of blood in the heart. Heart valves, their significance
3. The heart cycle and its phases.
4. Mechanical and sound manifestations of cardiac activity.
5. Morphological characteristics of the heart muscle.
6. Functional characteristics of the myocardium.

Digestion

1. Digestion. Functions of the digestive system and classification of digestive processes. Principles of the regulation of digestion. The food center, hunger and satiety motivation. Innervation of the gastrointestinal tract.
2. The role of the nervous and humoral mechanisms of digestive regulation. Hormones of the gastrointestinal tract and their characteristics. Phases of secretion of the digestive glands. Starting influence on the gastrointestinal tract. Methods of studying the function of the digestive tract.
3. Digestion in the mouth. Salivary glands and methods for their study. Regulation of salivation. Swallowing.
4. Digestion in the stomach and methods of its study in animals and humans. The structure and innervation of the gastric glands. Composition of gastric juice. Curves of secretion for different foods. Regulation of gastric secretion, the phase of secretion and their mechanisms. Hormones of the stomach.
5. Digestion in the duodenum. Methods of research.

Excretion

1. System of excretion and renal function. Methods of studying of the kidneys functions.
2. Structure and blood supply of the nephron. Yuxtaglomerular complex.
3. The theory of urination. The mechanism of the glomerular filter. Composition of primary urine.
4. Proximal reabsorption and its mechanisms.
5. Functions of the proximal tubule and the loop of Henle. Intensity of proximal reabsorption. Dilution and concentration of urine.
6. Distal reabsorption. Displacement of reabsorbtion in hydremia and water scarcity. Mechanisms of sodium reabsorption.
7. The involvement of the kidneys in the regulation of homeostasis: the exchange of water, osmotic pressure, pH, isonia, BP, erythropoiesis. Excretory, secretory and metabolic functions of the kidneys.

Blood system

1. The concept of the blood system. The ratio of plasma and shaped elements. Composition of blood.
2. Morphological characteristics of erythrocytes. Regulation of erythropoiesis.
3. The structure of hemoglobin. Determination of the amount of hemoglobin in the blood. Color indicator.
4. Characteristics of leukocytes. Leukogram and its meaning.
5. Calculating of the number of leukocytes in the blood.

Human life activity during different types of activity

1. Higher and lower nervous activity (Sechenov,Pavlov). Conditioned and unconditioned reflexes. Their similarities and differences. Classification of unconditioned and conditioned reflexes, their components. Signals of conditioned reflexes.

2. Principles of conditioned reflex activity of the cortex. The procedure and conditions for the formation of conditioned reflexes.
3. The mechanism of formation of conditioned reflexes (Pavlov, Gasto, Yoshii). Scheme of the conditioned reflex arc.
4. The biological nature of conditioned reflexes. Theory of convergent closure of time constraints by P.K. Anokhin. Conditional reflexes of the second and third orders.
5. Modern ideas about the mechanisms of memory. Types of memory. Physical and biochemical theory of memory.

Respiration

1. Respiration system, its importance for the organism. The main stages of the breathing. Functional system for maintaining the consistency of the gas composition of the blood.
2. Respiratory cycle. Physiology of the respiratory tract. Regulation of their clearance. The significance of ciliated epithelium.
3. External breathing. The mechanism of a calm and deep inhale and exhale. Pressure in the pleural cavity, its change during breathing. The Donders scheme.
4. Dynamic and static resistance to breathing. Elastic properties of the lungs and chest wall. Surfactant and its meaning.
5. Ventilation of the lungs, its unevenness in different parts of the organism. Alveolar and pulmonary ventilation. Spirometry and spirography.

Criteria exam assessment

Assessment exam for the discipline consists of the current and the examination ratings.

Exam rating is determined as follows:

Stage Points	**Баллы**
Test	5
Interviews	25
Situation tasks assessment	10

Criteria for the assessment test

"Excellent" (5 points) – 91% or more correct answers to test items.

"Good" (4 points) – 81-90% of correct answers to test items.

"Satisfactory" (3 points) – 71-80% of correct answers to test items.

Unsatisfactory (0 points) – 70% or less correct answers to the test tasks.

The criteria for the evaluation of answers to theoretical questions

6 points – the student thoroughly understands the material covered, gives clear answers, comprehensive; kable to assess facts independently; demonstrate the ability to justify conclusions.

5 points – the student thoroughly understands the material covered, clear answers and comprehensive, able to assess facts independently argues, is characterized by the ability to justify conclusions and explain them in a logical sequence, but allows some inaccuracies and errors of a General nature.

4 points – student understands the material covered, but can't theoretically justify some conclusions.

3 points – the student's partially responses with significant gaps in the material covered

2 points – the student's response is correct only in part, the explanation of the material is subject to bad errors.

1 point – the student has a General idea about the topic, but is not able to rationalize his thoughts or has only partial understanding of the subject.

0 points - no answer.

• the rating of "excellent" − the total amount of rating points is 87–100;

• "good" – the total amount of rating points is 73–86;

• evaluation of "satisfactory" − the total amount of rating points is 60–72;

• evaluation of "unsatisfactory" exhibited student, if the total amount of rating points is less than 60.

"Excellent" – the story complete, competent, logical; fluency in medical terminology; answers to additional questions, a clear brief.

"Good" – the lack of a coherent story with a single error in the particulars; individual errors in medical terminology; answers to additional questions correct, is not clear.

"Satisfactory" – the story is competent enough, incomplete, with errors in detail; errors in medical terminology; answers to the additional questions is not clear, with errors in the particulars.

"Unsatisfactory" – the story of an illiterate, incomplete, to blunder; ignorance of medical terminology; answers to supplementary questions wrong.

Examples of situational task

Task 1

As a result of the accident, the patient had a rupture of the spinal cord and paralysis of the lower extremities occurred. What other functions were impaired.

Task 2

Why under the water to determine where the sound comes from is much more difficult than in the air?

Task 3

A right-hand man with a leading right hand, right eye, right ear, right leg, had a brain injury on one side, as a result of which he lost the ability to speak and perceive speech.

On which side and in which areas of the hemispheres did the injury occur? How are disorders of this kind called? On the medical examination, the recruit showed a shortening of the right upper limb. At the age of 10, there was a fracture of the surgical neck of the humerus with disconnection along the metaepiphyseal line. Explain the reason for the lag in the growth of the limb.

Criteria for assessing of situational task

"Excellent" - the answer is complete, correct and logical; Proficiency in medical terminology;
"Good" - the answer is not logical enough with single errors in details; Single errors in medical terminology;
"Satisfactory" - the answer is not correct enough, incomplete, with errors in details; Errors in medical terminology;
"Unsatisfactory" - the answer is incorrect, incomplete, with gross mistakes; Ignorance of medical terminology;

Examples of topics of term paper

1. Physiology as a subject, its importance for medicine and tasks. Relationship of physiology with other medical sciences. The role of physiology in human activity. Physiology and technology.
2. History of the development of physiology. Physiological representations in the Ancient World, in the Middle Ages and in the 16th and 17th centuries.
3. Development of physiology in the 18-19 centuries.
4. Development of physiology in the 20 century. Physiological laureates of the Nobel Prize.
5. Lability. Maximum and optimal rhythm. Assimilation of the rhythm according to Ukhtomsky.
6. Physiology of work. Hypokinesia as a component of modern work. Negative effect of hypokinesia on the organism.
7. Muscle fatigue. Causes and prevention.
8. The role of the teachings of Sechenov and Pavlov in the creation of the materialistic foundations of physiology.
9. The relationship between hypothalamic-pituitary system and endocrine glands.
10. Regulation of endocrine glands dependent on the pituitary gland.
11. Biomechanics of muscles.

Estimated activities at term paper performance

Activities	Points
Analysis of the task formulated in the form of a technical need and all available initial data for its implementation, screening out redundant and identifying missing characteristics	15
The choice of methods for solving the tasks and the rationale for choosing	15
Performing of the task	15
Analysis of the obtained decision and its qualitative evaluation	15

Activities	Points
Total	***60***
Protection of term paper	40
Total	**100**

7. Educational, methodological and informational means provided for subject

a) Basic literature:

1. Normal physiology: textbook / LZ Tel [and others]; Ed. LZ Telya, NA Agadzha-nyana. - M.: Litterra, 2015. - 768 p. http://www.studmedlib.ru/book/ISBN9785423501679.html
2. Normal physiology: textbook / ed. K.W. Sudakova. - M.: GEOTAR-Media, 2015. - 880 p. http://www.studmedlib.ru/book/ISBN9785970435281.html

b) Additional literature:

1. Human physiology: Atlas of dynamic schemes: a textbook / K.V. Sudakov, V.V. Andrianov, Yu.E. Vagin, I.I. Kiselev. - 2 nd ed., Rev. and additional. - M.: GEOTAR-Media, 2015. 416 p. http://www.studmedlib.ru/book/ISBN9785970432341.html
2. Atlas of Physiology: Textbook: 2 t. / A.G. Kamkin, I.S. Kiseleva. - 2013, 408 p. http://www.studmedlib.ru/book/ISBN9785970424193.html

c) Software and Internet resources:

1. Department site - http://dep_fizch.pnzgu.ru/
2. The Journal "Human Physiology" - https://elibrary.ru/title_about.asp
3. Stanford University - https://www.stanford.edu
4. MIT - Massachusetts Institute of Technology - http://web.mit.edu/

Licensed Software:

- "Microsoft Windows"; 00037FFEBACF8FD7 registration number, contract number SD-130712001 from 12.07.2013;

- "Kaspersky antivirus" 2016-2017, registration number KL4863RAUFQ, contract number CP-567116 from 29.08.2016;

Free software:

Open Office; Mozilla Firefox; Google Chrome; Adobe Acrobat Reader.

8. Material and technical means provided for subject

№	Name of special classroom and classroom for independent work	Equipment of special classroom and classroom for independent work
1.	Classroom 10 – 310, housing 10, 19,3 м^2	- Multimedia learning tools (multimedia projector, screen, computer). - Educational board - A set of electronic presentations / slides of lectures. - A set of tests on the discipline and discipline in general. - Demonstration tables. - Training aids. - Laboratory equipment, equipment, tools, utensils. - Training table - 12 pcs. - chairs - 24 pcs.
2.	Classroom 10 – 311, housing 10, 19,3 м^2	- Multimedia learning tools (multi-media projector, screen, computer). - Educational board - A set of electronic presentations / slides of lectures. - A set of tests on the discipline and discipline in general. - Demonstration tables. - Training aids. - Laboratory equipment, equipment, tools, utensils. - Training table - 9 pcs. - chairs - 18 pieces.

The study program for the discipline "Normal physiology" is drawn in accordance with the federal state educational standard of higher education and academic plan for the course 31.05.01 General Medicine.

The program developers:

Head of Department "Human Physiology", Professor _____ N.I. Mikulyak
Assoc. Professor of Department "Human Physiology" _____ M.I. Morozova
Assistant lecturer of Department "Human Physiology" _____ A.I. Mikulyak

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The program was discussed and agreed at the department meeting

Records № 12 on « 4 » марта 2016

Head of Department "Human Physiology" _____ N.I. Mikulyak

The program is agreed with the Dean of the Faculty of General Medicine of PSU

Dean of the Faculty of General Medicine _____ I.YA. Moiseeva

The program was approved by methodological commission of the Medical Institute

Records № 7 on " 5 " 03 2016

Chair of the methodological commission _____ O.V. Kalmin

Verification, correction: Department of Foreign Languages,
Assoc. Professor _____ E.V. Shepeleva

РП - НФ. англ.

Data on re-approval of the program for consecutive academic years and record of alterations

Academic year	Departments' decision (records №, date, head of the department signature)	Introduced alterations	Page numbers		
			changed	new	annulled
2016/2017	Протокол № 1 2.09.2016	Рабочая программа утверждена без изменений			
2016/2017	Протокол № 13 17 мая 2017	На основании прик. за Минобра и науки РФ № 320 от 10.05.2017 квалиф. „Врач общей практики" заменяется на „Врач-лечебник"	1		
2017/2018	Протокол № 1 4.09.2017	Добавлено в п. 5 описание применения образовательных технологий к обучающимся с ограниченными возможностями здоровья и инвалидам	15		
2017/2018	Протокол № 1 4.09.2017	Рабоч. программа утверждена с изменениями			
2018/19	Пр. № 13 5.06.18	Раб. программа переутв. без изменений			
2019/2020	Протокол № 11. от 17.06.19	Раб. программа переутверждена без изменений			