


Ministry of Science and Higher Education of the Russian Federation Ulyanovsk State University	Form	
F – Working Program of Subject		

**APPROVED BY**

The decision of the Academic Council of the Institute of  
Medicine, Ecology and Physical Culture of ULSU

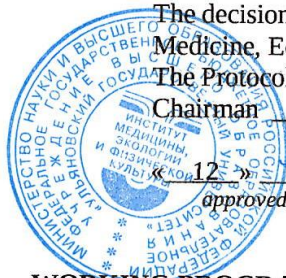
The Protocol No.9/ 229 of May "12" 2021

Chairman (Vladimir I. Midlenko)

(signature, signature clarification)

« 12 » May 2021

approved by department, implementing the subject



**WORKING PROGRAM OF SUBJECT**

Subject	<u>Normal physiology</u>
Faculty	Medical named after T.Z. Biktimirov
Department	<u>Physiology and Pathophysiology</u>
Course	<u>Second</u>

Direction (specialty) 31.05.01 General Medicine

The form of education full-time

Date of introduction in the teaching process at Ulyanovsk State University: «1» september 2021



The program was updated at the Department Meeting: Protocol No. 1 of 29 August 2022


The program was updated at the Department Meeting: Protocol No.     of     /     /    

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Information about developers:

Full name	Department	Position, academic degree, title
Gening T.P.	Physiology and Pathophysiology	Head of the Department, Dr.Bio.Sci., professor
Abakumova T.V.	Physiology and Pathophysiology	PhD in Biology, associate professor

ACCORDED WITH	ACCORDED WITH
Head of the Department Physiology and Pathophysiology implementing the Subject	Head of the Graduating Department of Hospital Therapy
 /Tatyana P.Gening/ (Signature) (Full Name)	 /Marina A. Vise-Khripunova (Signature) (Full Name)
« <u>11</u> » <u>May</u> 2021	« <u>11</u> » <u>May</u> 2021

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**• 1. AIMS AND OBJECTIVES OF DEVELOPING DISCIPLINE:**

**• The purpose of the Course**

- to form students' systematic knowledge about holistic living organism and its parts, the basic laws of functioning and mechanisms of their regulation of the interaction between each other and with environmental factors, on the physiological basis of clinical and physiological methods of research used in functional diagnosis and the study integrative human activity.

**Objectives:**

- the formation of students ' systematic approach to understanding the physiological mechanisms underlying interaction with environmental factors and implementation of adaptive strategies of the human body, the implementation of the normal functions of the human body from the standpoint of the theory of functional systems;
- the study of the methods and principles of the research assessment of the state regulatory and homeostatic systems of the organism in the experiment, taking into account their applicability in clinical practice;
- teaching students methods of evaluation of human functional state, state regulators and homeostatic in different types of purposeful activity;
- formation bases of clinical thinking based on the analysis of the nature and structure interorganic and intersystem relations from the position of integrated physiology for future practical activities of the doctor.

**2. PLACE OF DISCIPLINE IN THE STRUCTURE OF THE MAIN PROFESSIONAL EDUCATIONAL PROGRAMS:**

The discipline "Normal Physiology" refers to the basic part of the general professional program B1.0.09 of the structure of the program of specialty. For its successful development, knowledge of anatomy, neuroanatomy, histology, embryology, cytology, embryonic development of body tissues, biochemistry is required. "Normal physiology" forms the knowledge base for the subsequent study of pathophysiology, clinical pathophysiology, propaedeutics of internal diseases, the basics of functional and laboratory diagnostics, pathological anatomy, clinical pathological anatomy, pathophysiology of extreme conditions, anesthesiology, intensive care resuscitation, forensic medicine, surgical gastroenterology and endoscopy and for state final certification.

**3. THE LIST OF PLANNED RESULTS OF TRAINING ON THE DISCIPLINE (MODULE), ASSOCIATED WITH THE PLANNED RESULTS OF THE EDUCATIONAL PROGRAM**

The process of studying the discipline aimed at forming skills to the assessment of morphological and functional, physiological conditions and pathological processes in the human body for professional applications (GPC-5)

Code and name implemented competence	The list of planned learning outcomes in the discipline (module), correlated with indicators of achievement of competences
GPC-5	<p><b>Know:</b></p> <ul style="list-style-type: none"> <li>• structure, topography and development of cells, tissues, organs and systems of the body in interaction with their normal function, anatomical and physiological, age-sex and individual characteristics of the structure and development of a healthy and large organism; the structure of the human body in relation to function, the functional systems of the human body, their regulation and self-regulation when exposed to the external environment is normal;</li> <li>physicochemical essence of the processes occurring in a living organism at the</li> </ul>



molecular, cellular, tissue and organ levels; basic patterns of development and vital activity of the organism based on the structural organization of cells, tissues and organs; histo-functional features of tissue elements, methods of their study.

**be able to:**

- use educational, scientific, popular science literature, the Internet for professional activities,
- use physical, chemical and biological equipment; work with magnifying equipment (microscopes, optical and simple loupes); to give a histophysiological assessment of the state of various cellular, tissue and organ structures; interpret the results of the most common methods of functional diagnostics used to identify pathologies of the blood, heart and blood vessels, lungs, kidneys, liver and other organs and systems; evaluate the results of electrocardiography; spirometry; thermometry; hematological indicators; to distinguish in blood serum the normal values of the levels of metabolites (glucose, urea, bilirubin, uric acid, lactic and pyruvic acids, etc.), to register an ECG in experimental animals and humans, to calculate and analyze the leukocyte formula; determine and evaluate the results of electrocardiography; spirometry; thermometry; hematological parameters.

**own:**


methods of assessing the physiological state of the patient; methods of physical examination of the patient.

#### 4. TOTAL WORK CONTENT OF DISCIPLINE

4.1. Volume of the discipline is **5 credit units (180 hours)**.

4.2. Volume of the discipline by activity types (hours):

Training activity types	Quantity of hours (Full-time attendance)		
	Total number as planned	Including semesters	
		3 semester	4 semester
1	2	3	4
Students work with the teacher	108	36	72
Auditorium learning:			
Lectures	36	18	18
Practical occupations, seminars occupations	72	18/6*	54/6*
Laboratory work (laboratory practice)	-	-	-
Self-guided work	36	18	18
Current control (quantity and type: examination (test), colloquim (discussion group), library-research paper)	8 colloquiums	3 colloquiums	5 colloquiums
Term paper	-	-	-

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Middle assessment types (exam, pass)	36	credit	exam
Total workload in credit hours	180(5)	54/6*	126/6*


\* - the number of hours spent in an interactive form

**If necessary, you can use in the educational process partially / exclusively distance educational technologies**

### 4.3. Content of the discipline (module). Distribution of hours within the subjects and the training activity types:


Mode of study: **full-time**

Name of sections and themes	Total	Types of academic studies					
		Auditorium learning			Training in an interactiv e form	Self- guided work	Form of current knowledge control
		lectur es	worksho ps, seminar s	laboratory work			
1	2	3	4	5	6	7	8
Section 1. Physiology of excitable tissues.							
1. Subject, research methods and significance of physiology. Basic properties of living things (irritability, excitability).	3	1	1	-	-	1	Test; Oral survey; Checking the solution of situational tasks
2. General properties of excitable tissues. Indicators of excitability Bioelectric phenomena in living systems	3	1	1	-	1	1	Test; Oral survey; Checking the solution of situational tasks
3. Types of muscle contraction. Reduction mechanism. Muscle physiology.	3	1	1	-	-	1	Test; Oral survey; Checking the solution of situational tasks
4. Physiology of muscles. Muscle strength and work. Exhusion	3	1	1	-	1	1	Test; Oral survey; Checking the solution of situational tasks
5. Properties of peripheral nerves and myoneural synapses	5	2	1	-	1	2	Test; Oral survey; Checking the solution of situational tasks

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6. Final lesson “General properties of excitable tissues. Neuromuscular physiology ”	1		1	-	-	-	Test; Oral survey; Checking the solution of situational tasks
<b>Section 2. Physiology of the Central Nervous System</b>							
7. Reflex as the main form of nervous activity. Reflex arc analysis.	3	1	1	-	-	1	Test; Oral survey; Checking the solution of situational tasks
8. Properties of nerve centers. Features of the conduction of excitation in the nerve centers. General principles of coordination activities in the central nervous system	3	1	1	-	1	1	Test; Oral survey; Checking the solution of situational tasks
9. The process of inhibition in the central nervous system.	3	1	1	-	-	1	Test; Oral survey; Checking the solution of situational tasks
10. Spinal cord and its functions	3	1	1	-	1	1	Test; Oral survey; Checking the solution of situational tasks
11. Brain stem: medulla oblongata, pons varoli, midbrain, reticular formation. Brain stem reflexes. The cerebellum and its functions.	3	1	1	-	-	1	Test; Oral survey; Checking the solution of situational tasks
12. The diencephalon and its functions. Physiology of the autonomic nervous system	5	2	1	-	-	2	Test; Oral survey; Checking the solution of situational tasks
13. Final lesson "Physiology of the Central nervous	1		1	-	-	-	Test; Oral survey; Checking the

system".							solution of situational tasks
<b>Section 3. Physiology of analyzers, higher nervous activity.</b>							
14. Physiology of analyzers. Visual analyzer	3	1	1	-	-	1	Test; Oral survey; Checking the solution of situational tasks
15. Physiology of analyzers (auditory, vestibular, somatosensory, olfactory, gustatory analyzers)	3	1	1	-	-	1	Test; Oral survey; Checking the solution of situational tasks
16. Neurophysiological features of the human brain. The method of developing a conditioned reflex. Cortical inhibition	3	1	1	-	1	1	Test; Oral survey; Checking the solution of situational tasks
17. Higher mental functions of a person	5	2	1	-	-	2	Test; Oral survey; Checking the solution of situational tasks
18. Final lesson "Physiology of analyzers. Higher nervous activity "	1		1	-	-	-	Test; Oral survey; Checking the solution of situational tasks
<b>Section 4. Visceral functions</b>							
19. Physiology of blood circulation. Physiology of the heart. The main properties of the heart muscle.	5	1	3	-	1	1	Oral survey
20. Physiology of blood circulation. Physiology of the heart. Phases of the cardiac cycle. Regulation of the activity of the heart. Methods for studying the activity of the heart.	5	1	3	-	1	1	Test; Oral survey; Checking the solution of situational tasks
21. Physiology of blood circulation. Physiology of the heart. Blood pressure. Regulation of vascular	7	2	3	-	1	2	Test; Oral survey; Checking the solution of situational tasks

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tone.							
22. Final lesson: "Physiology of blood circulation. Physiology of the Heart".	3	-	3	-	-	-	Test; Oral survey;
23. Breth Physiology. External respiration. Gas exchange in the lungs. Transport of gases by blood. Respiration regulation.	7	2	3	-	1	2	Oral survey
24. Final lesson on "Breth Physiology"	3	-	3	-	-	-	Oral survey
25. Physiology of digestion. Methods for studying the functions of the gastrointestinal tract. Digestion in the oral cavity. Digestion in the stomach.	5	1	3	-	-	1	Test; Oral survey; Checking the solution of situational tasks
26. Physiology of digestion. Digestion in the intestines. Pancreas and liver functions. Motility of the gastrointestinal tract and its regulation. Absorption in various parts of the gastrointestinal tract.	7	2	3	-	1	2	Test; Oral survey; Checking the solution of situational tasks
27. Final lesson in the section: "Physiology of digestion."	3	-	3	-	-	-	Oral survey
28. Physiology of excretion. Clinical methods for the study of renal function. Regulation of kidney function.	5	1	3	-	-	1	Test; Oral survey; Checking the solution of situational tasks
29. Physiology of the endocrine glands	5	1	3	-	-	1	Test; Oral survey; Checking the solution of situational tasks
30. Metabolism and energy. Main and working exchange. Thermoregulation	7	2	3	-	1	2	Test; Oral survey; Checking the solution of situational tasks
31. Final lesson in the sections: "Excretion", "Metabolism", "Endocrinology", "Thermoregulation".	3	-	3	-	-	-	Oral survey



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32. Physiology of blood. Corpuscular elements of blood. Physiology of erythrocytes. Respiratory function of blood.	5	1	3	-	-	1	Test; Oral survey; Checking the solution of situational tasks
33. Physiology of blood. Physiology of leukocytes. Physicochemical properties of blood.	6	2	3	-	-	1	Test; Oral survey; Checking the solution of situational tasks
34. Physiology of blood. Clotting of blood. The doctrine of blood groups.	7	2	3	-	-	2	Test; Oral survey; Checking the solution of situational tasks
35. Final lesson "Blood Physiology"	3	-	3	-	-	-	Oral survey
36. Lesson on practical skills.	4	-	3	-	-	1	Oral survey
Total:	180	36	72	-	12*	36(18/18)	

#### Used interactive educational technologies

The following educational technologies are used in conducting classroom studies: lectures and practical exercises. When organizing classes in an active and interactive form, information technologies, computer simulation programs “Virtual Workshop on Human and Animal Physiology”, situational tasks and tests are used, in discussing the results of which the discussion technology is used: brainstorming technology is used when studying new theoretical material before performing practical assignments.

### **5. CONTENT OF THE COURSE (MODULE).**

#### **Section 1. Principles of functioning of individual organs and systems**

**Theme 1.1.** Introduction. General physiology and biophysics of excitable tissues.

The contribution of Russian physiologists in the world physiological sciences (A. M. Filomafitsky, I. Glebov, F. V. Ovsyannikov, I. M. Sechenov, N. A. Mislavsky, I. P. Pavlov, N. E. Vvedenskii, A. A. Ukhtomsky, A. F. Samoilov, L. A. Orbeli, P. K. Anokhin, K. M. Bykov, E. A. Asratyan, V. V. Parin, V. N. Chernihivovskiy, L. S. Shtern, etc.). The deepening of the analytical division. Human physiology and scientific-technical progress. Physiology as a scientific basis for the diagnosis of health, healthy lifestyle and foresight of functional status and human performance. A systematic approach to the study of purposeful human behavior in the natural environment, the conditions of industrial labor, sports and other species of activity. The study of the influence of social factors on the life processes of a human organism. Cell. Its function. Body tissues (epithelial, connective, muscular and nervous), the main special features of their functions. The concept of irritability and excitability. Indicators of excitability, curve "force - time"


**Theme 1.2.** Bioelectric phenomena in living systems.

The resting potential (PP). The action potential (AP). Modern ideas about the process of excitation. The ratio between of excitability phases and phases of PD. The effect of DC on the tissue. Characteristic of connective tissue with low excitability (connective, bone, cartilage). Biopotentials of glandulocytes. The secretory cycle.

**Theme 2.** Physiology of nerve fibers, nerves and muscles.

Fiber type A, B, C. Features of conduction of the excitation along the nerve fibers and at nerve trunks. The parabiosis (N. E. Vvedensky).



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**Theme 2.1.** Physiology of muscles Functional characteristics of muscle tissue. The mechanism of muscle contraction. Physiology of smooth muscle.

**Theme 3.** General physiology of the central nervous system. Structure and properties of synapses. The role of the central nervous system in an integrative adaptive activity of the body. The blood-brain barrier. Research methods of CNS functions. The reflex principle of the activity of nervous system. The structure of the reflex arc. Integrative activity of the neuron. Properties of receptors, the mechanism of their excitation. Functional property of synapses. Features of the structure and classification. The physiological meaning of the doctrine of the regulation functions for general medicine and clinical disciplines, for forming concepts about health and healthy lifestyles.

**Theme 3.1.** The transfer of excitation synapses. EPSP, IPSP. Properties of the nerve centers. Mechanisms of transmission of excitation. Neurotransmitter theory. Postsynaptic potentials. The concept of nervous center. Physiological properties of the nerve centers.

**Theme 4.** Inhibition of the nerve centers. Coordination of reflex activity. Modern views on the mechanism of central inhibition. The main types of the inhibition and its role. General principles of coordination. The interaction between the processes of excitation and inhibition as the coordination of reflexes. The iconic function of the brain: gnosis, praxis.

**Theme 5.** Physiology of the spinal cord, brainstem and cerebellum. Characterization of spinal animals. Spinal shock. Bell - Majandi law. The centers of the spinal cord. Conducting function of the spinal cord. The centers of the medulla oblongata and the pons. Conducting function of the medulla oblongata. Tonic reflexes of the brain stem Reflex activity of the midbrain. Cerebellum and its afferent and efferent connections. The interaction between the cortex and nuclei of the cerebellum. Anti-gravity function of the cerebellum.

**Theme 6.** Physiology of the reticular formation Features of neural organization. Connection of the reticular formation with the conductive paths of the brain. Upstream and downstream influences of the reticular formation.

**Theme 7.** Physiology of the diencephalon, limbic system and basal nuclei. Physiology of the autonomic nervous system.

The thalamus - the collector of afferent pathways. Functional characterization of associative and non-specific nuclei.

**Theme 7.1.** Physiology of the autonomic nervous system. Structural and functional characteristics of the autonomic innervation. Visceral and autonomic ganglia. The influence of the sympathetic and parasympathetic divisions of the ANS to the innervated organs. Autonomic centers. Patterns of autonomic reflexes. Role of the autonomic nervous system in the integration of functions in the formation of holistic behavioral acts.


**Theme 8.** Physiology of the heart. Physiological properties of cardiac muscle. Cardiac cycle and its phases. Hemodynamic functions of the heart.

**Theme 8.1.** Methods of assessment of cardiac activity The heart tones. Phono- and electrocardiography.

**Theme 9.** The regulation of heart activity. Autoregulation, neural, humoral regulation. Reflexes of the heart. Integration of mechanisms that regulate heart function.

**Theme 10.** The basic laws of hemodynamics blood flow regulation. The basic laws of hemodynamics. The changes of blood pressure, resistance and velocity of blood flow in different parts of the bloodstream. Arterial and venous pulse.

**Theme 10.1.** Blood flow regulation. Microcirculation. Regional circulation. Methodology of the study of organ blood flow (occlusive, plethysmography, ultra-sound and electromagnetic flowmetry). Methods of investigation of microcirculation. Vasomotor center, vasomotor nerves. Neural and humoral influences on vascular tone. Pressor and depressor reflexes. The base tone. Features and regulation of capillary blood flow. Functional features of the pulmonary circulation, coronary blood flow. Factors of a healthy lifestyle,

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which prevent disturbance of the circulatory system. Age peculiarities of the circulatory system. The change of organ blood flow during muscular exertion, eating, pregnancy, hypoxia, stress and other conditions.

**Theme 11.** The lymphatic system, its structure and functions. Chylopoiesis and mechanisms of its regulation. The factors for lymph circulation and the mechanisms of its regulation.

**Theme 12.** Physiology of respiration. External respiration. The mechanism of inhalation and exhalation. The stages of the breathing process.

The mechanism of inhalation and exhalation. The pressure in the pleural cavity. The elastic properties of the lungs. Spirometry, spirometry, pneumotachography.

**Theme 13.** Digestion in the stomach, duodenum, small intestine and colon. Motility and absorption. Digestion in the stomach. The exocrine activity of the pancreas. Regulation of pancreatic secretion. Role of the liver in digestion. Digestion in the jejunum and the ileum. Cavity and membrane hydrolysis. Digestion in the large intestine. The significance of microflora and gas in the intestines. Motility and absorption in different parts of the gastrointestinal tract.

**Theme 14.** Metabolism and energy. Physiology of metabolism and energy.

Plastic and energy role of the nutrients. Caloric and respiratory factors. Basal and active metabolic rate. The concept of water balance. Energy expenditure of the body in different kinds of work. Age peculiarities of the system of metabolism. Physiological fundamentals of nutrition.

**Theme 14.1.** Thermoregulation.

Systemic mechanisms of the thermoregulation and heat transfer. Mechanisms of hardening of the body. Age peculiarities of the system of thermoregulation.

**Theme 15.** Physiology of the urinary system

The main processes occurring in the kidney: filtration, secretion. Regulation of urine formation and urination. Adaptive changes of renal function in different environmental conditions. The skin as an excretory organ. The functions of sebaceous and sweat glands, regulation of their activities. Non-excretory functions of the skin. **Theme 16.** Physiology of the endocrine glands

Physiology of the endocrine glands and their role in the formation of functional systems of the organism. The mechanism of action of hormones. Methodology of the study of the endocrine glands. The hypothalamic-pituitary system. Thyroid gland. Parathyroid gland. Endocrine function of the pancreas. The adrenal glands. The sex glands. The epiphysis. The thymus gland. Age features of the endocrine system.

**Theme 17.** Blood physiology

Basic constants of blood and self-regulatory mechanisms of maintaining. Protective functions of blood. The blood group. RH factor. Mechanisms of blood coagulation. Lymph, its composition, quantity, functions, physiological significance. Extravascular fluid environment of the body (interstitial, spinal, synovial, pleural, peritoneal, liquid medium of the eyeball, slime) and their role to provide vital activity of the cells of the body.

**Theme 17.1.** The body and its defense system.

The factors ensuring the integrity of the organism. Barriers of external and internal environment of the body. Immunity and its types. Protective reflexes.

**Theme 18.** Physiology of analyzer systems.


The doctrine of I. P. Pavlov about the analyzers. The role of different types of afferentation in the formation of functional systems of an organism. Classification of receptors. Methods of studying the excitability of the receptors. Acupressure points and the principle of reflexology.

## **Section 2. Functional systems of the human body, their regulation and self-regulation when exposed to the external environment**

**Theme 19.** The doctrine of functional systems.

System organization of functions. Nodal mechanisms of the functional system.

**Theme 20.** Transport of gases by blood.

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Functional system, providing optimum level of gases for metabolism. Transport of gases by blood. Dissociation curve of oxyhemoglobin. The composition of inhaled, exhaled and alveolar air. The respiratory center. Automaticity of RC. Peripheral and central chemoreceptors. Impact of gas composition on RC: pH of blood and cerebrospinal fluid. Regulation of respiration by the hypothalamus, limbic system and cortex. Functional respiratory system. Age peculiarities of the respiratory system.

**Theme 20.1.** Functional system, providing optimum for metabolism level gases. Functional respiratory system. Age peculiarities of the respiratory system.

**Theme 21.** Functional digestive system and the place of digestive processes in it.

Food motivation. Physiological basis of hunger and satiety. Digestion in the mouth. Swallowing, its phases, the methodology of the study, regulation.

**Theme 21.1.** Food motivation. Physiological basis of hunger and satiety.

Food motivation. I.P. Pavlov about the food centre. Regulation of feeding behavior. Age peculiarities of the digestive system.

**Theme 22.** Higher nervous activity. Conditional reflexes.

Objective methods of studying GNI (I. P. Pavlov). Regularities of formation and existence of conditional reflexes. Mechanisms of formation of temporary connections. Architecture of a holistic behavioral act (P. K. Anokhin).

**Theme 22.1.** The adaptation of the body to the personal conditions of existence.

Bioecology (chronobiology). The idea of discrete time-personal processes in the body. Cyclic processes. Physiology of adaptation. Individual adaptation. Types, phases and criteria of adaptation.

**Theme 22.2.** Purposeful behavior.

Purposeful behavior as a form of behaviour that leads to the achievement of the body's adaptive result. Physiological basis of employment. Features of physical and mental work.

**Theme 22.3.** The problem of fatigue of the whole organism.

Active leisure (I. M. Sechenov) and its mechanisms. Optimal conditions for work and leisure as the basis for a long period of high working ability of the body. Age features of purposeful behavior.

**Theme 23.** The phenomenon of inhibition in the higher nervous activity. Types and mechanisms of inhibition of HNA. Physiology of sleep. Physiological basis of hypnotic states.

**Theme 24.** Types of HNA. The doctrine of the 1st and 2nd signal systems. Memory.

The doctrine of I. P. Pavlov about the types of HNA. Methods for determination of HNA. The power relationships law and its changes in different functional states of the organism. Attention. Perception. Emotions and their biological role. Memory, its types and mechanisms. Thinking. Consciousness. Speech.

**Theme 25.** Physiology of the reproductive system.

The stage of reproduction. Anatomical and physiological basis of reproduction. The formation and mechanisms of sexual motivation. Phase of the sexual cycle in men. Features of the phases of the sexual cycle in women.

**Theme 26.** Physiology of pain and pain relief.

The pain as the feeling and condition. Nociception. Antinociception. Physiological mechanisms of pain and analgesia.

**Theme 27.** Practical skills.

Determination of the number of erythrocytes in the blood

Determination of hemoglobin content in blood by the method of Sahli

The calculation of the color index of blood


Determination of the erythrocyte sedimentation rate by Panchenkov's method

Determination of the number of leukocytes in the blood

Observation of different types of hemolysis

Determination of osmotic resistance

Determination of blood groups

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Determination of Rh  
 Determination of coagulation time  
 Determination of bleeding time by Duke  
 Listening to heart tones.  
 Definition of blood pressure by the method of Korotkov.  
 The ECG recording.  
 Palpation of the pulse.  
 Measurement of the vital capacity of the lungs and its components.  
 Pneumography.  
 Calculation of basal metabolic rate.  
 The study of the reaction time.  
 Dynamometry.  
 Assessment of the field of view.  
 Assessment of visual acuity.  
 Research methods of taste sensitivity.

## 6. THEMES OF PRACTICAL LEARNINGS AND SEMINARS.

### Section 1. Patterns of functioning of individual organs and systems

**Theme 1.** Subject and methods of research in physiology. The basic properties of the living (irritability, excitability, metabolism). General properties of excitable tissues.

1.1. Acquaintance with the physiological equipment (demonstration).

**Purpose:** to acquaint students with amplifying equipment, promotional and registration of equipment used in physiology as an experimental science.

**The content of the work:** Acquaintance students with existing equipment and explanation the working principles of the equipment and its possibilities in studies of the functional state of the organism.

**Results:** mastering the material.

1.2. Preparing a neuromuscular preparation.

**Purpose:** to prepare the preparation of the gastrocnemius muscle and sciatic nerve.

**The content of the work:** Immobilize the frog, skin, prepare the two legs preparation, prepared the one leg preparation, isolate sciatic nerve, calf muscle and thigh.

**Results:** made neuromuscular preparation and its drawing in the notebook protocols.

1.3. The determination of the threshold of irritation for muscle and nerve.

**Purpose:** to determine the thresholds of irritation to the muscles and nerve and compare them.

**The content of the work:** Set the electrodes from the electrical stimulator to the nerve and choose irritation threshold (indirect irritation of the muscles). Register the contraction of muscle. Muscle contraction during indirect stimulation reveals the threshold irritation to the nerve. Transfer electrodes at the same current strength directly into the muscle. Increases stimulus strength to the muscle contraction (this is the threshold of stimulation for the muscle).

**Results:** the obtained data bring to the table, analyze and make a conclusion about the excitability of nerve and muscle.

1.4. The dependence of the height of the muscle contraction from the irritation force.

**Purpose:** to experimentally prove the existence of dependence in the force of contraction of the muscle overall on the strength of irritation.


**The content of the work:** Irritate calf muscle of neuromuscular preparation (directly or through the nerve) with threshold and suprathreshold current. Record the height of the contraction.

**Results:** Measure the height of the contraction depending on the strength of the stimulus and make the conclusion.

1.5. The measurement of rheobase and chronaxie of skeletal muscle of the frog (spec. description).

**Theme 2.** Bioelectric phenomena in living systems.

2.1. The first experiment of Galvani.

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**Purpose:** to experimentally reproduce the classic works of Galvani.

**The content of the work:** Prepare the preparation of the hind legs of a frog (with mandatory preservation sciatic nerve plexus in spinal region). The copper jaws of the tweezers Galvani bring under the sciatic nerve in the spinal cord, and the other concern muscle. See the contraction of the muscle.

**Results:** The first experience of Galvani was reconstituted.

2.2. Experience of Matteucci (secondary tetanus).

**Purpose:** to experimentally reproduce the classic works of Matteucci.

**The content of the work:** Prepare two nerve-muscle preparation of the frog. The nerve of one of the preparation is applied to the muscle of the other. The electrodes from the stimulator bring under the first nerve. Stimulate nerve of the first preparation with volleys of rectangular impulses, achieving a tetanic contraction of the muscles of the second preparation. After the muscle tetanic contraction, one can observe a tetanic contraction of the first preparation.

**Results:** The experience of Matteucci was reconstituted.

2.3. Experience of Muller-Kelliker (demonstration-spec. description).

**The content of the work:** To determine the rheobase, install the electrodes on studied tissue (nerve or muscle of nerve-muscle preparation) or group of muscles of the animal. The voltage applied to the electrodes, infinitely variable from zero to maximum. By changing the voltage applied to the electrodes in the direction of increasing from zero set rheobase for a given tissue. Rheobase is evaluated at a constant minimum duration of the stimulus (useful time), then double the magnitude of the applied voltage (2 rheobase). The scale of the pulse duration is set to zero and smoothly changing the duration of the feed pulse upward, evaluate the chronaxia.

**Themes 3-4.** Types of muscular contraction. The contraction mechanism. Physiology of muscles. Force and muscle work. Exhaustion.

3.1. Recording curve single muscle contraction and its analysis.

**Purpose:** to perform the registration and the analysis of the curve of a single muscle contraction.

**The content of the work:** Prepare nerve-muscle preparation of the frog and strengthen it in the vertical myograph. Using an electric stimulator pick up the amperage at which cause quite a strong muscle contraction. Registration a single muscle contraction. By means of the curve of muscle contraction determines the phase of contraction and their duration.

**Results:** record the curve of a single muscle contraction.

3.2. Summation of muscle contractions.

**Purpose:** to show that skeletal muscle obeys the power law relationship during contraction.

**The content of the work:** Registration the contraction of the gastrocnemius muscle of a frog during stimulation with an increasing power.

**Results:** the greater the stimulus the greater the amplitude of muscle contraction (up to the plateau).

3.3. Complete and incomplete tetanus.

**Purpose:** to registration an incomplete and complete tetanus of the gastrocnemius muscle of the frog.

**The content of the work:** Registration a single muscle contraction. Increasing the frequency of irritation to 10-20 Hz, registration incomplete tetanus, further increasing the frequency, registration complete tetanus.


**Results:** Complete tetanus is a tetanus in which stimuli to a particular muscle are repeated so rapidly that decrease of tension between stimuli cannot be detected, and incomplete is a tetanus in which each stimulus causes a contraction to be initiated when the muscle has only partly relaxed from the previous contraction.

3.4. The role of the motor end plate in initializing tiredness.

**Purpose:** to demonstrate that fatigue in the neuromuscular preparation is localized in the neuromuscular synapse.

**The content of the work:** Prepare the preparation of the gastrocnemius muscle of the frog. Write down first muscle contraction by indirect (via nerve), and then by direct stimulation of the gastrocnemius muscle.



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**Results:** In the indirect stimulation of the muscle we get a curve of fatigue, the amplitude of muscle contraction is restored by direct stimulation.

3.5. The dependence of the amount of work to the load of the muscle.

**Purpose:** to determine the dependence of the amount of work to the load of the muscle.

**The content of the work:** the neuromuscular preparation of the frog stimulate by average current. Registration a single muscular contraction of the muscle without load and with the progressive increase of the load. The work of the muscle is calculated by the formula:  $A=P \times l$ , where A is the muscles work, P-force, l-size of contraction of muscle.

**Results:** maximum work is performed at medium loads.

3.6. The determination of muscle power.

**Purpose:** to determine the maximum value of the load that the muscle is able to raise.

**The content of the work:** the neuromuscular preparation of the frog stimulate by average current. Registration a single muscular contraction of the muscle without load with the progressive increase of the load. Find the maximum value of the load that the muscle is able to lift.

**Results:** determine the strength of the gastrocnemius muscle of the frog.

3.7. Recording EMG of skeletal muscle in human.

**Purpose:** to register the action potentials of skeletal muscles in human.

**The content of the work:** using the electromyography EMG is recorded on Biopac Student Lab.

**Results:** the EMG of skeletal muscle of the human.

**Theme 5.** Properties of peripheral nerves and neuromuscular synapses.

5.1. The speed of conduction of excitation along the nerve (demonstration).

**Purpose:** to determine the speed of excitation along the sciatic nerve of a frog.

Multimedia task.

5.2. Bilateral conduction of excitation along the nerve.

**Purpose:** to show the existence of a bilateral conduction of excitation along the nerve.

**Responsibilities:** Prepare the preparation of hind legs of a frog. Separate the sciatic nerve in the lower third of the thigh. Cut underneath the muscles and thigh. Irritate the nerve and observe the contraction of the muscles of the of the thigh and lower leg.

**Results:** picture of the experience, the conclusion about the existence of a bilateral conduction of excitation along the nerve.

5.3. Experimental confirmation of the law of the anatomical and physiological integrity

**Purpose:** to show the necessity of preserving the anatomical and physiological integrity of the nerve fibers for conducting the excitation.

**The content of the work:** Stimulate nerve of neuromuscular preparation of the frog legs and see the muscle contraction. On the nerve for 5 minutes a cotton swab is applied with soaked in 2% solution of novocaine. Include stimulant and observe the lack of contractions. Wash the nerve with Ringer's solution, stimulate. Note that the contractions appear again.

**Results:** for the conduction of excitation the nerve must be anatomically and physiologically intact.

**Theme 6.** The final lesson on the topic: General properties of excitable tissues. Neuromuscular physiology.

**Theme 7.** Reflex as the basic form of nervous activity. The reflex arc. Its analysis.


7.1. Analysis of the reflex arc.

**Purpose:** to prove that after the violation of the integrity of any part of the reflex arc, reflex is not carried out.

**The content of the work:** the spinal frog hung on the tripod. Stimulate the thigh of the hind legs of a frog with filter paper moistened with a solution of sulfuric acid and observe the reflex. Observe the lack of reflex on acid irritation when you turn off the separate links of the reflex circuit. Cut off the skin receptors, skinning. Exclude afferent fibers, blocking novocaine or cutting the sciatic nerve. Turn off nerve centers, destroying the spinal cord.

**Results:** integrity of all parts of the reflex arc is necessary to implement the reflex.



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## 7.2. Measuring the reflex time by Turk and its dependence on stimulus.

**Purpose:** to measure the time of spinal reflex in frogs by Turk and to establish the dependence of the reflex time on the strength of stimulus.

**The content of the work:** the spinal frog hung on the tripod. Dip the fingertips of one of the back legs of frog in a beaker with 0.1% solution of sulfuric acid and determine the time to onset of response. Wash the foot with water. I repeat the definition of the reflex time three times. Calculate the average reflex time. To determine the dependence of the reflex time from stimulus irritate the same foot over strong sulphuric acid solutions.

**Results:** the higher strength of the stimulus (higher concentration of acid), the shorter the time of reflex by Turk.

**Theme 8.** Features of the conduction of excitation and the general principles of coordination in the central nervous system.

### 8.1. Summation of excitation in the nervous centers.

**Purpose:** to verify the ability of the nerve centers to the serial and spatial summation of excitation.

**The content of the work:** Stimulate the thigh of spinal frog with current of variable frequency.

**Results:** reflex response is not caused by one stimulus, only by several stimuli.

### 8.2. Central Sechenov inhibition.

**Purpose:** to reproduce the experience of I.M. Sechenov demonstrating intracental descending inhibition effects in the central nervous system.

**The content of the work:** Determine the reflex time by Turk before and after the deposition of salt crystals in the region of the optic tubercles of frog.

**Results:** the reflex time by Turk becomes longer after stimulation of the region of optic tubercles.

### 8.3. Reflexes of Golts. Reciprocal inhibition of reflexes.

**Purpose:** to show that the reflex time becomes longer after simultaneous stimulation of multiple receptive fields.

**The content of the work:** Determine the reflex time by Turk during the stimulation of the frog receptors of the abdominal cavity.

**Results:** the reflex time by Turk becomes longer.

### 8.6. Poisoning frogs by strychnine (demonstration).

**Purpose:** to demonstrate the phenomenon of hyperreflexia when blocking inhibition in the spinal cord.

**The content of the work:** After the injection strychnine to the frog, frog is placed under the hood.

**Results:** after a while, observe generalized reflexes with a slight irritation.

**Theme 9.** Spinal cord, the medulla oblongata and their functions.

### 9.1. Spinal shock.

**Purpose:** to reproduce spinal shock after the removal brain of the frog.

**The content of the work:** Remove the brain of the frog and measure the time from the time of removal till the time of occurrence of reflex.

**Results:** determine the time of spinal shock in frog.

### 9.2. The segmental nature of reflexes.

**Purpose:** to demonstrate the segmental nature of the spinal reflexes.

**The content of the work:** Stimulate different receptive field with filter paper moistened with acid.

**Results:** observe various motor reflexes.


### 9.3. Spinal reflexes in humans (special description)

### 9.4. Unipolar irritation of the medulla oblongata in frogs (special description).

**Purpose:** to demonstrate that centers of blinking and swallowing are in the medulla oblongata.

**The content of the work:** remove bone plate of the brain of the frog, draw out the structure of the brain. In the medulla oblongata electrode 1 (1 - 2 mm) insert, and the second electrode (base) fix on the foot of the frog and choose the current a bit more than subthreshold so that on closing the circuit the frog was observed in the act of swallowing and blinking.

**Results:** observe blink and swallow reflexes.

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**Theme 10.** The midbrain, the cerebellum, the diencephalon, their functions. Physiology of the autonomic nervous system.

10.1 Unilateral destruction of the cerebellum in the frog.

**Purpose:** to show the role of the cerebellum in the regulation of the tonus of the skeletal muscles.

**The content of the work:** Destroy one side of the cerebellum in the frog.

**Results:** Watch manege movements of the frog in the pan of water.

10.2. Tonic reflexes at the turn of the head.

**Purpose:** to demonstrate that by changing the position of the head relative to the torso arise postural-tonic reflexes.

**The content of the work:** change posture of the Guinea pig.

**Results:** observe static reflexes aimed at the restoration of the body in a natural position.

10.3. Stato-kinetic reflexes (lift reactions).

**Purpose:** to show that when a body moves with acceleration, the tone of skeletal muscles changes.

**The content of the work:** A Guinea pig on a special board sharply was raised and sharply was lowered.

**Results:** see "lift" reflexes.

10.4. Observation of eye nystagmus in humans.

**Purpose:** to demonstrate stato-kinetic reflex during movement with the angular acceleration.

**The content of the work:** Person in a special chair is rotated around its axis at a rate of 1 revolution per second.

**Results:** see head and eye nystagmus.

**Theme 11.** The final session on the theme: Physiology of the central nervous system.

**Theme 12.** Physiology of blood circulation. Basic properties of cardiac muscle.

12.1. Graphic registration of the contractions of the frog heart.

**Purpose:** to record the cardiogram of frog.

**The content of the work:** In spinal frogs open the chest cavity to reveal the heart, pick up at its top and record its contractions.

**Results:** cardiogram of frog.

12.2. The analysis of the conduction system of the heart (the experience of Stannius).

**Purpose:** to show the existence of gradient of **heart automaticity**.

**The content of the work:** Apply I, II and III ligature of Stannius, sequentially counting the number of heartbeats.

**Results:** after each ligation the heart rate decreases consistently.

12.3. Features of excitability of the heart and extrasystoles.

**Purpose:** to show that after an extraordinary stimulation in early diastole extrasystole occurs. **The**

**content of the work:** Record the cardiogram of frog in the norm and after causing irritation at the beginning of diastole.

**Results:** after the extrasystole, ventricles receive compensatory pause.

**Theme 13.** Physiology of blood circulation. Regulation of cardiac activity.

13.1. The influence of irritation of vagosympathetic nerve on the heart activity of the frog.

**Purpose:** to demonstrate the negative tropic effects in the heart by the increased tone of the vagus.

**The content of the work:** Record the cardiogram of frog before and after stimulation of short branch lets of vagosympathetic trunk.

**Results:** during stimulation, get slowing up to stop the heart.


13.2. Exogenous reflexes on heart (reflexes of Goltz, reflex of Danini-Aschner).

**Purpose:** to demonstrate the associated vagal reflexes.

**The content of the work:** Irritate the receptors of the abdominal cavity (reflex of Goltz) and receptors eyeballs (reflex of Danini-Aschner).

**Results:** observe the slowing of the heart rate.

13.3. The effect of temperature on the activity of the heart.

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**Purpose:** to show that when the temperature changes, in the area of the sinus node the frequency of heart contractions changes.

**The content of the work:** Count the number of heartbeats in spinal frogs at the norm; after heating and after cooling to 10 degrees region of the SA node.

**Results:** observe respectively increase and decrease of heart rate.

13.4. The effect of temperature on the activity of the heart.

**Purpose:** to show that when the temperature changes, in the area of the sinus node the frequency of heart contractions changes.

**The content of the work:** Count the number of heartbeats in spinal frogs at the norm; after heating and after cooling to 10 degrees region of the SA node.

**Results:** observe respectively increase and decrease of heart rate.

13.5. Influence on the heart activity of potassium and calcium ions.

**Purpose:** to observe the humoral regulation of the cardiac activity.

**The content of the work:** Count the number of heartbeats in spinal frogs in normal, after adding via cannula CaCl<sub>2</sub> and after washing – KCl.

**Results:** observe the gain and, consequently, a slowing of the heart rate.

**Theme 14.** Physiology of blood circulation. Phases of the cardiac cycle. Research methods of cardiac activity.

14.1. Percussion and auscultation of heart tones of a human.

**Purpose:** to familiarize with the technique of listening to heart tones of a human.

**The content of the work:** With a phonendoscope on certain areas of the chest listen to the heart tones. The mitral valve is heard at the location of the cardiac impulse in the fifth intercostal space, on the finger medial to the nipple line. The tricuspid valve is heard at the lower end of the sternum. The semilunar valve of the pulmonary artery is heard in the second intercostal space, somewhat to the left of the left edge of the sternum. The semilunar aortic valve is heard in the second intercostal space on the right, near the edge of the sternum.

**Results:** note the first tone – deaf and long, it coincides with cardiac impulse (systolic tone). Second tone – more short and sharp (diastolic).

14.2. The finding of a cardiac stimulus in humans.

**Purpose:** to determine the cardiac impulse in humans.

**The content of the work:** the cardiac impulse can be to hear or see in the bulging form in the region of the fifth intercostal space to the left of the midclavicular line.

**Results:** identified the cardiac impulse.

14.3. ECG recording and its transcript.

**Purpose:** to familiarize with the principles and techniques of electrocardiography.

**The content of the work:** the testee lay on the couch. Electrodes applied in accordance with the types of overlap with bipolar leads and simultaneously fix the electrode on the right foot. Record the ECG. Indicate on the ECG curve the tines and spacing.

**Results:** recorded in three standard ECG leads.

14.4. The counting pulse and the measure of duration of the cardiac cycle in humans by heart rate.


**Purpose:** to familiarize with the methodology to determine the duration of the cardiac cycle.

**The content of the work:** Find the pulse of the radial artery in a man. Count the number of pulse beats in 5 seconds several times for 3 minutes. 5 divide into each number, thereby calculating the duration of one cardiac cycle. Calculate the average duration of the cardiac cycle. Then determine the number of pulse beats per 1 minute, 60 is divided by the number found and find the average duration of the cardiac cycle.

**Results:** compare the results of two methods of counting.

**Theme 15.** Physiology of blood circulation. Blood pressure. The regulation of vascular tone.

15.1. Measurement of blood pressure in humans.

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**Purpose:** to familiarize with the method of measuring the blood pressure according to the method of Riva-Rocci and according to the Korotkov method.

**The content of the work:** Define systolic and diastolic blood pressure by auscultatory Korotkov method: apply the cuff to the shoulder, put a stethoscope on a throbbing brachial artery, inject the air into the cuff, releasing the air listen to the vascular tones. The time of occurrence of tones corresponds to the systolic pressure, and the time of disappearance - the diastolic. By palpatory method of Riva-Rocci determine the maximum pressure. Pressing the radial artery, inject the air into the cuff on the shoulder until there is no longer a pulse. Watching the pressure in monometer, releasing the air. When the pressure in the cuff is a little less than systolic, pulse appears.

**Results:** a measurement of blood pressure in two ways.

15.2. The definition of BP during exercise.

**Purpose:** to determine the BP by method of Korotkov during exercise.

**The content of the work:** Define the BP at rest and after 20 squats.

**Results:** after exercise, systolic blood pressure increases.

15.3. The effect of vasoconstrictor nerve fibers of the sciatic nerve in the regulation of vascular tone of the capillaries of swimming membranes of the frog.

**Purpose:** to show that the size of the lumen of the vessels depends on nervous influences.

**The content of the work:** Under the microscope observe the blood flow in the vessels of swimming membrane of the frog in norm and after transection of the sciatic nerve.

**Results:** observe vasodilation.

15.4. Observation of the capillaries of the skin.

**Purpose:** study of capillary circulation.

**The content of the work:** as the observations use capillary loops of skin, covering the base of the nail. Assess the blood flow in the capillaries in the norm and after compression of the veins of the arm by cuff of sphygmomanometer.

**Results:** in the total pressure of artery by cuff, blood flow in the capillaries ceases.

**Theme 16.** The final lesson on the topic: Physiology of blood circulation

**Theme 17.** Physiology of respiration. External respiration. Gas exchange in the lungs. Transport of gases by blood.

17.1. Pneumography in humans.

**Purpose:** to obtain a pneumogram of person in different physiological states (hyperventilation, hypoventilation, while reading aloud).

**The content of the work:** using Biopac software, sensors of respiratory effort and a temperature sensor in the man register a pneumogram at rest, hyperventilation, hypoventilation, while reading aloud. Analyze the breathing pattern (depth, frequency, duration of respiratory phases).

**Results:** after hyperventilation as a result of hypocapnia breathing slows, after hyperventilation, an increase in the breathing rate is observed, arbitrary regulation of respiration is observed when reading aloud.

17.2. Spirometry. Definition of tidal volume, vital capacity of the lungs (VCL). Calculation of properly VCL and maximum ventilation (MV). The dynamic spirometry.

**Purpose:** to determine a person lung volumes.

**The content of the work:** to determine tidal volume, inspiratory reserve volume, expiratory reserve volume, and VC using a dry spirometer.


**Results:** determined lung volumes.

17.3. Random delay of breathing under different conditions with ECG registration (sample on the inhale and the exhale, with ECG, with counting).

**Purpose:** to evaluate the effect of CO<sub>2</sub> on the respiratory center.

**The content of the work:** Define a random delay of normal breathing at rest, after hyperventilation in the lungs and after exercise.

**Results:** the minimum random delay of respiration was determined after exercise.

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**Theme 18.** Physiology of respiration. Control of breathing.

18.1. The role of the vagus nerves in the regulation of respiration in warm-blooded animals.

**Purpose:** to examine the effect of transection of the vagus nerve in rats on breathing pattern.

**The content of the work:** perform a bilateral ligation of the vagus nerve of the animal under anesthesia, and compare the frequency and depth of breathing with intact animals.

**Results:** breathing becomes deeper and more rare.

18.2. Localization of the respiratory center.

**Purpose:** to determine the structure of the central nervous system, where is the respiratory center.

**The content of the work:** In warm-blooded animal perform the transection between the middle and the oblong brain and observe the breath. Rhythmic breathing is observed. After a transection between the dorsal and the oblong brain breathing quickens dramatically, and then completely stops, because the impulses from the respiratory center of the medulla oblongata to the motor neurons of the respiratory muscles are absent.

**Results:** the respiratory center is localized in the reticular formation of the medulla oblongata.

**Theme 19. The final lesson on the topic: Physiology of respiration.**

**Theme 20.** . The physiology of digestion. Methods of study of the gastrointestinal tract. Digestion in the oral cavity.

20.1. Enzymatic properties of saliva in humans.

**Purpose:** to study experimentally the composition and properties of human saliva.

**The content of the work:** collect the saliva in a test tube and filtered. Add saliva to the solutions of the starch paste, acidified starch paste, raw starch. In one of the test tubes mix the boiled saliva and starch paste. To control, starch paste is mixed with distilled water. The tubes were incubated for 5-10 min in an incubator at 37-38 degrees. One of the tubes with saliva and starch paste placed in a container with snow. The contents of all tubes is divided into two parts and add Lugol's iodine solution (for determination of starch) in one tube and carry out Trommer's probe (to determine the presence of sugar) in another.

**Results:**  $\alpha$ -amylase is most efficient in conditions close to the physiological conditions in the oral cavity (weakly alkaline medium, the temperature is 37 degrees).

20.2. Reflex salivation.

**Purpose:** to master the method used for mass research of summary salivation in humans, to mention hard-reflexive nature of the work of the salivary glands in humans.

**The content of the work:** in the oral cavity with gauze collect saliva released in 2 minutes at rest, with breath delay, with telling about the sliced lemon, when kneading cranberries in the bowl. Wipes impregnated with saliva are weighed.

**Results:** regulation of salivation is subject of conditioned and unconditioned reflex influences.

**Theme 21.** The physiology of digestion. Digestion in the stomach and intestines. The function of the pancreas and liver.

21.1. The composition and properties of gastric juice.

**Purpose:** to study experimentally the composition and properties of gastric juice.

**The content of the work:** Put equal portions of chopped fibrin in 10 tubes, in 11-13 tubes - chopped egg white, a piece of raw meat, and a piece of boiled meat, respectively. Pour the contents of the tubes with artificial and natural gastric juice and incubate at different acid and temperature conditions. Carry out the biuret reaction to check for protein in solution.


**Results:** the gastric juice works in an acidic environment.

21.2. Bile and its role in the digestive process.

**Purpose:** to study experimentally the composition of bile and its role in the digestive process.

**The content of the work:** Carry out the reaction of Pettenkofer for bile acids, Gmelin's reaction for bile pigments. Observe the action of bile on fats (bile emulsification of fats, the influence of bile on filtering fat).



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**Results:** we determined the composition of bile (bile acids, bilirubin) and its effect on fats (emulsification, filtration acceleration).

21.3. Enzymatic properties of intestinal juice.

**Purpose:** to investigate the action of enzymes of the intestinal juice on the digestion of products of the cleavage of proteins and carbohydrates.

**The content of the work:** Pour 3 ml of intestinal juice into 4 vials, one of them is boiled. Add in 1 and 2 vials a solution of peptone, 3 – a piece of fibrin, 4 – washed exposed film. Incubate for 45 minutes at 39 degrees. Divide the contents of the tubes into 2 parts and conduct the biuret reaction and the reaction of tryptophan with bromine water.

Pour 3 ml of 5% sucrose solution into 3 test tubes, add in them the intestinal juice, boiled intestinal juice and water respectively. Incubate for 30 minutes at 39 degrees. Carry out with them and the control test tube with sucrose solution Trommer test.

**Results:** intestinal juice has alkaline pH, cleavages peptones on dipeptides and amino acids, and sugars to hexoses.

**Theme 22.** The physiology of digestion. The motility of the gastrointestinal tract and its regulation. The physiology of digestion. Absorption in different parts of the gastrointestinal tract.

22.1. The effect of epinephrine and pilocarpine on the motion of an isolated loop of intestine.

**Purpose:** to determine the effect of epinephrine and pilocarpine on the motion of an isolated loop of intestine.

**The content of the work:** Isolated loop of intestine of rabbit is placed in a glass of warm Ringer's solution. Record with kymograph the contractions of the intestine in normal and while adding epinephrine and pilocarpine.

**Results:** when exposed to adrenaline, intestine contractions is reduced as when the sympathetic impact, under the influence of pilocarpine (analogue of acetylcholine) – become more frequent as when the parasympathetic influence.

22.2. Motor function of the digestive tract of warm-blooded animals.

**Purpose:** to study the characteristics of various motor functions of the gastrointestinal tract.

**The content of the work:** Fix an anesthetized animal on a wooden board, open the abdominal cavity. Dip in warm ringer's solution up to the shoulder.

**Results:** the stomach and intestines float freely in solution, preserving all kinds of motor activity.

22.3. Parietal digestion in the intestine.

**Purpose:** to prove the stimulating effect of a piece of the intestinal wall to the hydrolysis of starch by amylase in the intestinal juice.

**The content of the work:** Pour into 10 tubes 3 ml of the starch paste and 1 ml of Ringer's solution with hood from the jejunum wall. In test tubes, except 5 control tubes, drop a piece of washed small intestine and incubate at a temperature of 38 degrees. Extract from the thermostat by a single vial of the experimental and control series every 3 minutes. Perform the Trommer test.

**Results:** samples of Trommer are more intensive in test tubes, which are longer were treated and contained a piece of the intestinal wall.

22.4. Study of the mechanism of absorption of various solutions in an acute experiment. (The experience of Heidenhain).


**Purpose:** to study experimentally the absorption in the intestine of a mammal.

**The content of the work:** Open the abdominal cavity of an anesthetized rat and expose the intestines. Isolate the section of the small intestine with a length of 10-15 cm. At both its ends inject cannules, one of which is connected to a graduated burette, and the second to the bypass tube. Wash the system, clamp the outlet tube and fill the system with isotonic NaCl. Measure the amount of the dose of the solution absorbed within 10 min. The same perform with hypo- and hypertonic NaCl solutions.

**Results:** in hypotonic solution, the rate of absorption increases, and in hypertonic reduces, compared to isotonic.

**Theme 23.** The final session on the theme: Physiology of digestion.



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**Theme 24.** Blood physiology. Hemocytes. Physiology of red blood cells. Respiratory function of the blood.

24.1. Technique of blood sampling for counting erythrocytes.

**Purpose:** to learn the technique of blood sampling for counting erythrocytes.

**The content of the work:** Wipe the fourth finger of the left hand with cotton wool moistened with alcohol, then ether. Squeeze the pulp of the terminal phalanx laterally, and pierce the skin by sterile scarifier with quick and sharp movement. Remove the first drop of blood, use the following for analysis. In drop immerse the tip of the melangeur for red blood cells, gain blood to the mark of 0.5 so that the capillary was almost out of air. Carry the tip of the melangeur in a 3% solution of sodium chloride and gain it to the mark 101, i.e. dilute blood 200 times.

**Results:** get the blood, diluted 200 times, to count red blood cells.

24.2. The counting the number of red blood cells.

**Purpose:** to learn how to count the number of red blood cells.

**The content of the work:** Cover the Goryaev's chamber by a glass, apply a drop of blood diluted 200 times on the average area of the camera at the edge of the coverslip. The Goryaev's chamber is placed under the microscope. Count the cells in 5 large squares on the diagonal. Calculate the number of red blood cells by the formula:  $X=A*4000*200/80$ , where X is the desired number of erythrocytes, A - the number of red blood cells in 80 small squares.

**Results:** the results of the counting of red blood cells is compared with the their number in normal.

24.3. Measuring the amount of hemoglobin.

**Purpose:** get acquainted with the method of measuring the amount of hemoglobin in the blood according by the method of Sahli.

**The content of the work:** In a test tube of gemometr mix 0.1 N HCl solution (to the label) and 0.02 ml of blood. After 5-10 minutes add distilled water until the color will match the color of standard. The figure, standing at the level of the resulting solution, indicates the concentration of hemoglobin.

**Results:** get the value of the quantity of hemoglobin in the blood and compare with the indicator in normal.

24.4. The calculation of the color index.

**Purpose:** to familiarize with the method of calculating the color index of blood.

**The content of the work:** Calculate the color index by the formula:  $CIB=(H*3)/e$ , where H is the haemoglobin content, e – the number of red blood cells.

**Results:** get the colour index and compare it with the indicator in normal.

24.5. Measuring the ESR.

**Purpose:** to master a Panchekov method for measuring the erythrocyte sedimentation rate (ESR).

**The content of the work:** Wash the capillary with a 5% solution of sodium citrate, get the solution up to the mark with P and pour onto a watch glass. Twice gain the blood to the level K, the two portions release at the hour glass. Received blood with sodium citrate gain in the capillary up to the mark O and put in a tripod. An hour later determine the height in mm of the resulting column of plasma – erythrocyte sedimentation rate.

**Results:** get the value of the ESR and compare it with the indicator in normal.

**Theme 25.** Blood physiology. Physiology of leukocytes. Physico-chemical properties of blood.


25.1. Counting the number of leukocytes.

**Purpose:** get acquainted with the method of counting the number of leukocytes in the blood.

**The content of the work:** Dilute blood with acetic acid (5% solution dyed at Türk's method) 20 times. Fill the counting chamber with the drop of blood. Perform counting in 25 large squares. The number of cells calculate by the formula:  $X=(B*4000*20)/400$ , where X is the number of white blood cells, B – the number of white blood cells in 25 large squares.

**Results:** calculate the number of leukocytes in the blood and compared with the indicator in normal.

25.2. Estimation of osmotic resistance of erythrocytes.

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**Purpose:** to become familiar with one of the methods for the study of osmotic resistance of erythrocytes. To determine the minimum and maximum resistance of red blood cells.

**The content of the work:** In 12 tubes with sodium chloride solution of decreasing concentration contribute to 0.02 ml of blood, shake and leave in stand for 1 hour.

**Results:** note, at what concentration of sodium chloride partial hemolysis occurs - it is the minimum resistance of red blood cells. The maximum resistance is determined by the concentration of sodium chloride in the first test tube, where there is no draught and liquid is intensively colored.

25.3. Types of hemolysis.

**Purpose:** to show that hemolysis can be caused by various factors, having different mechanism of action.

**The content of the work:** In 4 tubes with saline, distilled water, 0.1% hydrochloric acid solution and 5% solution of ammonia add 2 drops of blood. Tubes with citrated blood put in the freezer for 1 hour and thaw in hot water.

**Results:** observe osmotic (in a test tube with distilled water), chemical (in test tubes with hydrochloric acid and the solution of ammonia) and thermal (in the test tube from the freezer) types of hemolysis.

25.4. Estimation of the viscosity of blood.

**Purpose:** to explore the method of estimation of the blood viscosity.

**The content of the work:** In the capillaries get water and blood to the mark "0". Gain blood level up to the mark "1". Note what division the water level stop.

**Results:** the viscosity of blood is equal to the amount of distance, traveled by the water, divided by the amount of distance traveled by the blood.

**Theme 26.** Blood physiology. Coagulation of blood. The doctrine of the blood groups.

26.1. The duration of bleeding.

**Purpose:** to get acquainted with one of the methods for estimation of the bleeding time.

**The content of the work:** Pierce the finger of the test subject, speaking a drop of blood with wool. Every 30 seconds the bleeding point of the finger is applied to the filter paper so that in each sector the imprint of only one drop was, until the blood won't stop. Count the number of tracks of blood drops.

**Results:** calculate the bleeding time, compare it to the norm.

26.2. The influence of oxalate and  $\text{Ca}^{2+}$  on the speed of blood clotting.

**Purpose:** to determine the effect of calcium on blood coagulation.

**The content of the work:** On the slide drip a drop of blood and determine the rate of coagulation. Mix a drop of blood with a drop of a solution of sodium oxalate, and then a drop of blood with a drop of solution of calcium, measure the speed of blood clotting.

**Results:** when adding sodium oxalate, clotting speed is slowed down because sodium oxalate binds calcium ions, and when adding calcium, clotting speed is increased because calcium is one of the coagulation factors.

26.3. Determination of blood groups.

**Purpose:** to master the methods of determination of blood groups, to determine your own blood type.

**The content of the work:** On a glass slide put on a drop of cyclones (anti-A, anti-B, anti-AB). Glass stick make to each drop of blood from a finger. Stir and look at the agglutination reaction.

**Results:** define group I (O) by the absence of agglutination in all drops, II (A)group - by agglutination with serums with anti-A and anti-AB, group III (B) - by agglutination with anti-B and anti-AB. Group IV (AB) - by agglutination with all three drops.


26.4. The definition of the RH factor.

**Purpose:** to master the technique of definition of the RH factor, to determine your own RH factor.

**The content of the work:** mix a drop of blood with an anti-D cyclone. Look at the reaction of agglutination of red blood cells.

**Results:** agglutination occurs if the blood is RH positive, agglutination does not occur, if the blood is RH-negative.

**Theme 27.** The final session on the theme: Physiology of blood.

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**Theme 28.** Metabolism and energy. Basal and active metabolism.

28.1. Estimation of basal metabolism by the Harris and Benedict's tables.

**Purpose:** to get acquainted with methods of evaluation of basal metabolism.

**The content of the work:** using a stadiometer and scales determine the height and weight of the test subject. In the tables of Harris and Benedict find the values corresponding to the weight, age and height of the test subject. Sum up the numbers from tables.

**Results:** a calculation of the basal metabolic rate.

28.2. Drafting of food rations.

**Purpose:** to study and master the basis of preparation of diets for adults and children.

**The content of the work:** Take the daily requirement for calories, protein, fats and carbohydrates and divide these values into parts corresponding to breakfast, lunch and dinner. From the table, which lists the caloric content of food, choose the required products and take the necessary number of them.

**Results:** the diet for a person of a particular gender and age.

**Theme 29.** Physiology of the endocrine glands.

29.1. The action of adrenaline on pupil of the frog's enucleating eye.

**Purpose:** to determine the effect of epinephrine to the pupil of the frog's enucleating eye.

**The content of the work:** 2 enucleated eyes of the frog place in a Petri dish and put on a bright light. Measure the diameter of each pupil. In one cup add 3 drops of epinephrine solution 1:1000. After 25-30 minutes measure the diameter of the pupil.

**Results:** the pupil of the eye, placed in a solution with adrenaline, considerably bigger than the pupil of the second eye.

29.2. The action of adrenaline on the contraction of the muscles of the small intestine.

**Purpose:** to determine the effect of adrenaline on the contraction of the muscles of the small intestine.

**The content of the work:** Register a contraction of the muscles of the small intestine before and after application of a solution of adrenaline.

**Results:** the motility of the small intestine becomes weaker after application of a solution of adrenaline.

29.3. Insulin effect on white mice.

**Purpose:** to observe the effect of excess insulin on white mice.

**The content of the work:** Inject 1 unit of insulin under the skin of hungry mouse and place the mouse in a separate glass jar. Monitor the status and behavior of the animal. Inject 1 ml of 10% glucose solution intraperitoneally.

**Results:** after injection of insulin signs of hypoglycemic shock occur, injection of glucose in a few minutes leads to the restoration of normal condition.

**Theme 30.** Physiology of excretion. Clinical methods of research of function of kidneys. Regulation of kidney function.

30.1. Study of sweating. Experience of Minor

**Purpose:** to master Minor's method of studying of sweating.

**The content of the work:** Dry moisten the palm and wipe with a solution of iodine. Powder oiled plot with starch. Dip the other hand into hot water. Observe the color change of the starch.

**Results:** in the place of sweat black spots form.


30.2. Observe of the process of urination in acute experiment.

**Purpose:** to observe the process of urination in mammals.

**The content of the work:** Open the abdominal cavity of an anesthetized rat. To the incision in the bladder injected a cannula connected to a polyethylene tube filled with tinted saline solution. Fix the bladder walls to the tube. The amount of urine output is evaluated by the displacement of the liquid level in the plastic tube. In the course of experience evaluate the basic diuresis, diuresis after a water load and after injection of antidiuretic hormone.

**Results:** after the water load, diuresis increases, and after injection of antidiuretic hormone reduce, compared to the main diuresis.

30.3. Monitoring the cleansing ability of the kidneys.

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**Purpose:** to demonstrate the cleaning ability of the kidneys by the experimental method.

**The content of the work:** Intravenously inject a solution of Evans blue to the rat.

**Results:** after some time observe a blue urine.

**Theme 31.** The final session on topics: Metabolism. Endocrinology. Thermoregulation. Excretion.

**Theme 32-33.** Physiology of analyzers.

32.1. Visual analyzer.

32.1.1. Reflex reactions of the pupil.

**Purpose:** to identify the reflex reaction of the pupil to light.

**The content of the work:** The test subject sits face to the light. Close his eye with a black paper and observe the reaction of another pupil. Quickly remove the paper and observe the reaction of both pupils.

**Results:** when closing one eye, there is dilation of the pupil of the second eye. When removing the paper, both pupils narrow.

32.1.2. Accommodation of the eye.

**Purpose:** to ensure that there is an accommodation of the eye.

**The content of the work:** Through the thin gauze look at printed text located at a distance of 50 cm from the eye. Fix a sight on the threads first, then letters.

**Results:** the accommodation is reflected in the fact that while fixing gaze on the letters, the threads of the gauze is not visible, and vice versa.

32.1.3. Definition of visual acuity.

**Purpose:** to master the method of evaluating visual acuity.

**The content of the work:** The test subject sits at a distance of 5 m from standard tables and covers one eye with a special shield. The experimenter specifies the test subject on the letters from the top row and falling down, and asked to name them.

**The content of the work:** calculate the visual acuity by the formula:  $V=d/D$ , where  $V$  is the visual acuity,  $d$  is the distance from the test table to the test subject,  $B$  - the distance from which the normal eye should clearly see this line.

32.1.4. Measuring the field of view.

**Purpose:** to master the technique of measuring the field of view

**The content of the work:** The test subject sits with his back to the light, putting his chin in the notch of the tripod Foster's perimeter. The test subject fixates with one eye on the white circle in the center of the arc of the perimeter, and closes the other eye with his hand. Move the white mark on the inner surface of the arc perimeter from 90 to 0 degrees and the test subject is asked to indicate the time when the mark will be visible a fixed eye. Note the angle. Thus studying several medians.

**Results:** draw a perimeter shot field of view.

32.1.5. The detection of the blind spot.

**Purpose:** to verify that when the projection of the object is in the blind spot of the retina, the object becomes invisible.

**The content of the work:** On a sheet of paper draw a circle and at a distance of 1 cm from it - the cross. The test subject covers the left eye, and look with right eye at the picture, zoom in and removing it until the image of the cross disappears.

**Results:** measure the distance from the drawing to the eye.

32.1.6. Binocular vision.

**Purpose:** to verify the presence of binocular vision.


**The content of the work:** At a distance of 20-30 cm from the eye fix a pin, and at a distance of 2-3 m – tripod.

**Results:** when the test subject fix his gaze on the pin, the tripod seems to be a double and vice versa.

**32.2. Auditory analyzer.**

32.2.1. The hearing test (audiometry).

**Purpose:** to master the methods of audiometry, to evaluate the hearing threshold.

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**The content of the work:** using the audiometer, in the headphones of test subject transmit a signal of a certain frequency and volume.

**Results:** the results of the study are recorded on audiometric form.

#### 32.2.2. Bone and air conduction of sound.

**Purpose:** to verify the presence of bone conduction of sound.

**The content of the work:** To determine the bone conduction, the stem of sounding tuning fork is applied to the middle of the crown of the test subject. Repeat the experience with a cotton swab in the ear. The stem of the tuning fork is applied to various bones of the skull. To compare bone and air conduction, perform the Rinne test (the stem of the tuning fork is applied to the mastoid process of the temporal bone to the disappearance of sound, then transferred to the ear, measure the time of hearing the sound).

**Results:** from the laid-ear sound seems to be stronger, bone conduction of different bones are different.

#### 32.2.3. Binaurally hearing.

**Purpose:** to verify the binaural nature of the hearing.

**The content of the work:** the tips of the tubes of the stethoscope insert into the ears of the test subject, from the back of the test subject sounding tuning fork bring to the stethoscope. Ask which side a sound is heard. Replace one tube of the stethoscope with the longer one.

**Results:** sound is heard from the side of the short tube of the stethoscope.

#### 32.3. Skin analyzer.

##### 32.3.1. Verification of the law of Weber-Fechner.

**Purpose:** in experimental conditions to test the law of Weber-Fechner and to establish the limits of its applicable.

**The content of the work:** glass plate, warmed to body temperature, put on the wrist. On the plate put plummet weighing 1 gram, add weights to 0.1 g until the test subject will mark a time of increasing pressure. The same is repeated for the plummet of other mass. The obtained data bring to the table.

**Results:** define a constant for each weight by the Weber formula:  $\Delta I/I=K$ , where  $\Delta I$  is the increment of irritation,  $I$  – irritation,  $K$  is a constant.

##### 32.3.2. Tactile sensitivity

**Purpose:** to determine the frequency location of tactile dots and a spatial threshold of tactile sensitivity for different body parts.

**The content of the work:** the eyes are closed. Touch the skin with Weber's compass with the greatest kept tips. Gradually extending the compass by 1 mm, continue touching, until the test subject feels two points of touch. The experiment is performed with different areas of skin.

**Results:** spatial threshold depends on irritated skin areas.

##### 32.3.3. Detection of thermal and cold spots in the skin.

**Purpose:** to prove the separate existence of two types of temperature receptors and determine their approximate number in an area of 1 cm<sup>3</sup>.

**The content of the work:** On the skin apply the stencil and touch alternately cold and hot rod of thermesthesiometer. Counting the points at which there is a feeling of cold/heat produced by zigzag lines in a square of stencil.

**Results:** counts of cold and heat spots in various parts of the skin.

##### 32.3.4. The experience of Aristotle.

**Purpose:** to verify the value of life experience in the process of perception of objects of the surrounding world.


**The content of the work:** Roll the ball index and middle finger. Then cross over the fingers and roll the ball again.

**Results:** in the first case feel one ball, two in the second.

#### 32.4. Taste analyzer. Measuring threshold sensitivity of taste perception.

**Purpose:** to measure threshold sensitivity of taste perception to sour, salty, sweet and bitter.



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**The content of the work:** On the tongue of the test subject, according to the topography of taste fields, pipette a drop of solution of a substance, starting with the lowest concentration and increasing to values at which the test subject will determine the taste of the substance.

**Results:** empirically found concentrations compare with normal sensitivity thresholds.

**Theme 34.** HNA. Functions of the cerebral cortex. Methodology the elaboration of a conditioned reflex. Cortical inhibition. Higher mental functions.

34.1. Develop defensive blink reflex.

**Purpose:** to develop defensive blink reflex of the test subject.

**The content of the work:** After the beep, direct a jet of air in the eyes of the test subject, causing blink movement. After a few repetitions leave only the sound.

**Results:** blink movement emerges at the sound – reflex has developed.

34.2. The study of mobility of nervous processes (Tapping test).

**Purpose:** to become familiar with one method of studying the mobility of nervous processes.

**The content of the work:** the test subject in the most rapid pace causes dots with the pencil in squares 1, 2, 3, 4. The transition from the square to the square takes place every 10 seconds.

**Results:** the stability or increasing of the number of points – good indicators of the functional state of the nervous system, its decreasing shows a weak of the mobility processes.

34.3. The evaluation of the capacity of short-term memory.

**Purpose:** to evaluate the capacity of short-term memory of test subject.

**The content of the work:** Before the test subject lay out 10 cards. After a minute take them out and ask the test subject to recall them. With the number of recalled cards calculate the capacity of short-term memory.

**Results:** compare the obtained value with the norm.

34.4. The study of attention, correction samples.

**Purpose:** to investigate attention.

**The content of the work:** the test subject deletes from the correction table specific letters for some time.

**Results:** the attention is judged by the number of errors per unit time.


**Theme 35.** The final session on topics: GNI. The analyzers.

**Theme 36.** Test session on practical skills.

## QUESTIONS

1. Determination of the number of erythrocytes in the blood
2. Determination of hemoglobin content in blood by the method of Sahli
3. The calculation of the color index of blood
4. Determination of the erythrocyte sedimentation rate by Panchenkov`s method
5. Determination of the number of leukocytes in the blood
6. Observation of different types of hemolysis
7. Determination of osmotic resistance
8. Determination of blood groups
9. Determination of Rh
10. Determination of coagulation time
11. Determination of bleeding time by Duke
12. Listening to heart tones.
13. Definition of blood pressure by the method of Korotkov.
14. The ECG recording.



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15. Palpation of the pulse.
16. Measurement of the vital capacity of the lungs and its components.
17. Pneumography.
18. Calculation of basal metabolic rate.
19. The study of the reaction time.
20. Dynamometry.
21. Assessment of the field of view.
22. Assessment of visual acuity.
23. Research methods of taste sensitivity.

## 7. LABORATORY WORK (LABORATORY PRACTICE) - NO

## 8. LIST OF THEMES OF TERM PAPERS, TESTS, LIBRARY-RESEARCH PAPERS - NO.

### 9. LIST OF QUESTIONS TO CREDIT:

Competence Index	№ task	Task conditions (task statement)
GPC-5	1.	Subject of physiology and classification of physiological disciplines.
	2.	Relation of physiology with other sciences.
	3.	Value of a normal physiology course for medicine.
	4.	Notion of excitability.
	5.	Excitability indicators.
	6.	Law of the power relations.
	7.	Law “everything or nothing”.
	8.	Membrane potential, its origin and properties
	9.	Action potential, its origin and properties
	10.	Local respond and its characteristic
	11.	Curve of excitability and origin of its phases
	12.	Effect of a direct current on tissue
	13.	Concept about a motor and neuromotor unit.
	14.	Physiological properties of muscles.



15.	Irritation of muscles and ways of registration.
16.	Single muscular contraction.
17.	Change muscle fiber excitability at its reduction.
18.	Summation and tetanus. Optimum and pessimum of muscular contraction.
19.	Modern theory of muscular contraction and relaxation.
20.	Force and muscle work.
21.	Exhaustion of the isolated muscle and exhaustion in the whole organism.
22.	Adaptation and trophic influence of sympathetic nervous system on skeletal muscles.
23.	Heat generation at excitement and contraction of muscles.
24.	Physiological features of smooth muscles.
25.	Differences of the smooth muscle from the skeletal muscle.
26.	Classification of nervous fibers.
27.	Distribution of excitement on myelin and non-myelin nervous fibers.
28.	Laws of excitement conduction on nervous fibers.
29.	Synapse. Structure, classification. Excitement transfer mechanism.
30.	Concept of the central nervous system. Definition of a reflex.
31.	Structure of a reflex arch.
32.	The neuron is a structurally functional unit of CNS`.
33.	Features of excitement emergence in neuron.
34.	Mechanisms of excitement emergence in receptors.
35.	Definition and types of inhibition in CNS`.
36.	Postsynaptic inhibition.
37.	Presynaptic inhibition.
38.	Sechenov Central inhibition.
39.	Simple inhibition chains.
40.	Spinal cord. Conduction and reflex functions.



41.	Functions of ventral and dorsal roots of a spinal cord.
42.	Segmental and intersegmental principle of a spinal cord.
43.	Spinal shock.
44.	Medulla. Bulbar animal.
45.	Conduction function of a medulla oblongata.
46.	Reflex function of a medulla oblongata.
47.	Tonic reflexes of the brainstem.
48.	Reticular formation of the brainstem.
49.	Midbrain. Conduction function of midbrain.
50.	Reflex activity of midbrain.
51.	Cerebellum and its function.
52.	Hypothalamus. Hypothalamus participation in the regulation of autonomic functions.
53.	Thalamus. Functional characteristics of major nuclear groups.
54.	Comparative characteristics of the sympathetic and parasympathetic divisions of the autonomic nervous system. The synergy and antagonism of their relative influence.
55.	Definition of the analyzer according to I.P.Pavlov. Functions of the analyzer.
56.	Visual analyzer
57.	Receptor apparatus. Photochemical processes in a retina
58.	Conduction part of the visual analyzer
59.	Cortical representation of the visual analyzer
60.	Accommodation. Visual field. Visual acuity
61.	Acoustic analyzer. Structure. Functions.
62.	Vestibular analyzer. Structure. Functions.
63.	Somatosensory analyzer
64.	Taste analyzer
65.	Olfactory analyzer

66.	Concept of reflex. Classification of reflexes.
67.	Rules of development of conditioned reflexes.
68.	The scheme and mechanisms of short circuit of temporary communications at development of conditioned reflexes
69.	Types of higher nervous activity. The doctrine about the first and second alarm systems.
70.	Inhibition in HNA.
71.	Concept of dominant (A.A. Ukhtomsky).
72.	

### QUESTIONS FOR THE EXAM.

Competence index	Task number	Question
GPC-5	1	The main stages of development of physiology.
	2	The contribution of I. P. Pavlov in the development of the russian physiology.
	3	Features of the modern period of physiology development.
	4	The reflex principle of nervous system activity (R. Descartes, P. Prochazka), its development in the works of I. I. Sechenov, I. P. Pavlov, P. K. Anokhin.
	5	Analytical and systematic approaches to the study of body functions.
	6	Humoral regulation, characteristics and classification of physiologically active substances. The relationship of the nervous and humoral mechanisms of regulation.
	7	The Anokhin's theory of functional systems and self-regulation of functions. Nodal mechanisms of the functional system.
	8	Irritability, excitability as the basis of tissue responses to stimulation. Stimuli, their types and characteristics.
	9	Modern ideas about the structure and function of membranes. Active and passive transport across membranes.
	10	Electrical phenomena in excitable tissues. The history of their discovery.
	11	Membrane potential and its origin.
	12	The action potential and its phase. The ratio of phases of excitability with the phases of the action potential.
	13	Excitability, methods of its evaluation.



Competence index	Task number	Question
	14	Single contraction and its types. Tetanus. The factors that influence its value. The optimum and pessimum irritation.
	15	Tetanus and its types.
	16	The modern theory of muscle contraction and relaxation.
	17	The evaluation of the force of muscle contraction. Dynamometry.
	18	The spread of excitation on non-myelinated and myelinated fibers. Features of their excitability and lability.
	19	Features of the structure and functioning of smooth muscles.
	20	The structure and classification of synapses. The mechanism of conduction of excitation in the synapses (electrical and chemical).
	21	Features of the structure and conduction of excitation in nerve-muscle synapses. Neurotransmitters, their synthesis, secretion, interaction with receptors.
GPC-5	22	Neuron as structural and functional unit of the CNS, its physiological properties and relationship to glial cells.
	23	Features of the conduction of excitation in the synapses of the CNS. Excitatory synapses and a variety of mediators in the CNS (EPSP).
	24	General principles of coordination of activity of the central nervous system.
	25	Properties of the nerve centers.
	26	Structural-functional features of somatic and autonomic nervous system.
	27	Inhibition in the CNS (I. M. Sechenov), its types and role. Modern concepts of the mechanisms of central inhibition.
	28	The main principles and peculiarities of propagation of excitation in the central nervous system. Convergence, divergence, unilateral conduct.
	29	Characterization of spinal animals. Spinal reflexes.
	30	The medulla oblongata and the pons, their participation in the processes of self-regulation functions. The centers of the medulla oblongata.
	31	Decerebration rigidity and the mechanism of its occurrence.
	32	Physiology of the cerebellum, its influence on the motility and autonomic functions of the body.
	33	Reticular formation of brain stem. Ascending activating effects on the cerebral cortex (G. Magoun, D. Moruzzi).
	34	The hypothalamus. Characteristics of the main nuclear groups. Part of the hypothalamus in regulation of autonomic functions and in the formation of emotions and motivations.





Competence index	Task number	Question
	35	The thalamus. Functional characterization of the major nuclear groups.
	36	Comparative characteristics of the sympathetic and parasympathetic divisions of the autonomic nervous system, the synergy and the relative antagonism of their influence.
	37	A stereotactic method and its importance for the study of the functions of the central nervous system.
	38	The theory of I. P. Pavlov about the analyzers.
	39	Characteristics of the visual analyzer. Receptor apparatus. Photochemical processes in the retina by the action of light.
	40	Adaptation of analyzers, its peripheral and central mechanisms.
GPC-5	41	Auditory analyzer. The mechanism of occurrence of the receptor potential in hair cells of the spiral ganglion. Theory of perception of sounds (G. Helmholtz, G. Bekesy).
	42	Features of conductor and cortical parts of the auditory analyzer.
	43	Receptor apparatus of analyzers. Classification, functional properties and features of receptors
	44	The vestibular analyzer.
	43	Conductive part of the visual analyzer. Features of chiasm optic tract.
	46	Theory of color perception (M. V. Lomonosov, G. Helmholtz, Hering)
	47	Biological significance of pain. The modern idea of the nociception and central mechanisms of pain. Antinociceptive system.
	48	Methods of studying the function of the visual analyzer (visual field, visual acuity, color vision).
	49	Classification of reflexes. Reflex path. Reverse afferentation. The concept of the adaptive result.
	50	Alteration of motor function in lesions of the cerebellum in humans.
	51	Physiological mechanisms of conditioned reflexes formation, their structural-functional basis. Development of ideas of I. P. Pavlov on the mechanisms of formation of temporary connections.
	52	Conditioned reflex as a form of adaptation of animals and humans to the changing conditions of existence. Classification of conditional reflexes.
	53	The mechanism of formation of conditioned reflexes.
	54	Conditioned reflex. Development of ideas of I. P. Pavlov on the mechanisms of formation of temporary connections.
	55	The doctrine of I. P. Pavlov on I and II signalling systems.



Competence index	Task number	Question
	56	The doctrine of I. P. Pavlov about the types of higher nervous activity. Types of inhibition.
	57	The modern idea of localization of functions in the cerebral cortex of the brain. Polyfunctionality of cortical regions.
	58	Functional asymmetry of the brain.
	59	Congenital form of behavior (unconditioned reflexes and instincts) and its importance for adaptive activities.
	60	Dynamic stereotype, its physiological nature, importance.
	61	Physiological mechanisms of sleep. Sleep phases. Sleep theory.
	62	Modern ideas about the functional organization of the brain.
GPC-5 GPC-5 PC-9	63	The concept of metabolism in the body. The processes of assimilation and dissimilation of substances. Plastical and energy role of nutrients.
	64	The heat production. Metabolism as a source of heat production. The role of individual organs in the heat production.
	65	The heat transfer. Methods of heat transfer from the body surface. Physiological mechanism of heat transfer.
	66	Basis of preparation of diets.
	67	Methods for determining energy expenditure. Direct and indirect calorimetry.
	68	Definition of respiratory quotient, its value for calculation of power consumption.
	69	The basal metabolic rate and importance of its calculation for the clinic.
	70	Chamber (closed) methods for evaluation of energy expenditure (N. M. Shaternikov).
	71	The energy balance of the body. Active metabolism. Energy expenditure of the body in different kinds of work.
	72	The value of mineral substances, microelements and vitamins in the body.
	73	Digestion in the mouth. Composition and physiological role of saliva. Salivation, its regulation.
	74	Methods of research of the gastrointestinal tract in animals and humans.
	75	Ignition (delicious) gastric juice and its value.
	76	Methods of study of bile formation and biliary excretion.
	77	Digestion in the stomach. The composition and properties of gastric juice. Regulation of gastric secretion. Phase separation of the gastric juice.
	78	Motor and evacuation function of the stomach, its regulation.



Competence index	Task number	Question
	79	The absorption of substances in different parts of the gastrointestinal tract. Types and mechanism of absorption of substances through biological membranes.
	80	Cavity and membrane hydrolysis of nutrients in different parts of the small intestine.
	81	Food motivation. Physiological basis of hunger and satiety.
	82	Role of the liver in digestion. The production of bile and its role in digestion.
	83	Methods of study of salivation in animals and humans (I. P. Pavlov, N. I. Krasnogorskyi).
	84	Digestion in duodenum. The exocrine activity of the pancreas. Regulation and adaptive nature of the pancreatic secretion to the types of food and food rations.
	85	Features of digestion in the colon.
	86	The composition and properties of intestinal juice. Regulation of secretion of intestinal juice.
	87	Endocrine function of the gastrointestinal tract.
	88	Methods of investigation of motor function of the gastrointestinal tract in humans and animals.
	89	Hormones of the pituitary gland, its functional connectivity with the hypothalamus and role in the regulation of activity of endocrine organs.
	90	Physiology of the adrenal glands. The role of hormones of the adrenal cortex in the regulation of body functions.
	91	Methods of studying the functions of the endocrine glands.
	92	Physiology of the thyroid and parathyroid glands.
	93	The composition of the blood. Basic physiological constants of blood and the mechanism of their maintenance.
	94	Electrolyte composition of blood plasma. The osmotic pressure of blood. Functional system, ensuring the constancy of the osmotic pressure of blood.
	95	Principles of manufacturing a blood-substituting solutions.
	96	Humoral regulation of erythro - and leukopoiesis.
	97	The concept of hemostasis. The process of blood clotting and its phases. Factors accelerating and slowing blood clotting.
	98	Characterization of the formed elements of blood (erythrocytes, leukocytes, platelets), their role in the body.
	99	Methods for counting erythrocytes and leukocytes.
	100	The blood group. RH factor. A blood transfusion. Blood-substituting solutions.



Competence index	Task number	Question
	101	Plasma proteins, their characterization and functional significance. The oncotic pressure of blood and its role.
	102	The concept of the blood system, its properties and functions.
	103	Method for the determination of the RH factor.
	104	Oxygen transport in the blood. Dissociation curve of oxyhemoglobin, its description.
	105	The transport of carbon dioxide by the blood. The importance of carbonic anhydrase.
	106	Calculation of color index of blood.
	107	Leukocytes and their types. Leukocyte formula. The functions of the various types of leukocytes.
	108	The red blood cells, their functions. Types of hemoglobin and its compounds, their physiological significance.
	109	Functional system that supports the constancy of acid-base balance.
	110	Coagulation, anticoagulation and fibrinolytic systems of blood, as main functional units of the system maintain its liquid state.
	111	Determination of ESR.
	112	Study of osmotic resistance of erythrocytes.
	113	Lymph, its composition, functions.
	114	Regulation of the level of glucose in the blood.
	115	Physiological properties and characteristics of the myocardium. Automatism of the heart. Modern ideas about substance, the nature and gradient of automatic.
	116	Heart, the value of its chambers and valve apparatus, the pressure variation and blood volume in the cavities of the heart in different phases of the cardiac cycle. Systolic and minute volume of blood.
	117	Electrocardiography. Vectorcardiography.
	118	The ratio of excitation, contraction and excitability of the heart in different phases of the cardiac cycle. The response of cardiac muscle to additional irritation. Extrasystoles.
	119	Heart sounds and their origin.
	120	Regulation of cardiac activity (myogenic, humoral, nervous).
	121	Humoral regulation of heart activity.
	122	Reflex regulation of the heart activity. Characterization of the effects of parasympathetic and sympathetic nerve fibers on the heart.
	123	Principles of analysis of the electrocardiogram.
	124	Electrocardiogram and its clinical significance.
	125	Phase analysis of the cardiac cycle.
	126	Blood pressure in different parts of the circulatory system. The factors that determine its magnitude. Types of blood pressure.



Competence index	Task number	Question
	127	Reflex regulation of systemic blood pressure. The value of vascular reflex zones. Vasomotor center.
	128	The basic laws of hydrodynamics and using them to explain the movement of blood through the vessels. The factors responsible for the movement of blood through the vessels.
GPC-5	129	Capillary blood flow and its features. Microcirculation and its role in the mechanism of fluid exchange and different substances between blood and tissues.
	130	Reflex regulation of vascular tone, vasomotor center.
	131	Arterial and venous pulse, their origin. Analysis of sphygmogram and phlebogram.
	132	Hormones of the adrenal medulla.
	133	Bloodless method of determining blood pressure (S. Riva-Rocci, I. S. Korotkov).
	134	Breath, its main stages. The mechanism of external respiration. Biomechanics of inhalation and exhalation.
	135	Methods of determining lung capacity. Spirometry, spirometry.
	136	The mechanism of respiratory failure in pneumothorax.
	137	Basic physiological mechanisms of respiratory changes during climbing to an high altitude.
	138	Gas exchange in the lungs. Partial pressure of gases O <sub>2</sub> and CO <sub>2</sub> in the alveolar air and the tension of gases in the blood.
	139	Functional system that provides constant gas composition of blood.
	140	Reflex regulation of respiration. The mechanism of change of the respiratory phase.
	141	Regulatory influence on the respiratory center from the higher parts of the brain (the hypothalamus, the cortex).
	142	The role of humoral factors in the regulation of respiration. The role of carbon dioxide. The mechanism of the first breath of a newborn baby.
143	The pressure in the pleural cavity, its origin and significance in different phases of the respiratory cycle.	
144	Definition of minute ventilation of the lungs in different conditions.	
145	The respiratory center (N. I. Mislavsky). Modern views on its structure and localization. Nervous and humoral regulation of the respiratory center.	
146	Nephron structure, blood supply. The mechanism of formation of primary urine, its composition.	

Competence index	Task number	Question
	147	The formation of the final urine, its composition and properties. Reabsorption in the tubules, the mechanism of its regulation. The processes of secretion and excretion in the renal tubules.
	148	The formation of primary urine.
	149	The process of urination, its regulation.
	150	The regulation of activity of the kidneys. The role of neural and humoral factors.
	151	Endocrine function of the kidneys.

## 10. SELF-GUIDED WORK.

Form of education Full-time

Independent work is made up of preparing for classes on questions for each lesson and preparation for intermediate control on questions for offset and examination. The following educational technologies are used in the organization of independent work of classes: Auditorium independent work on the discipline is performed on practical exercises under the direct guidance of the teacher and on his instructions. The workshop on normal physiology contains various experimental tasks in accordance with all the main sections of the theoretical course and is independently carried out in the laboratory of the Department of Physiology, equipped with laboratory equipment. As part of the course, students solve virtual problems - this is a simulator for independent work. Outside classroom independent work is performed by the student on the instructions of the teacher, but without his direct participation. The main types of independent work of students without the participation of teachers are: the formation and assimilation of the content of lecture notes on the basis of textbooks recommended by the lecturer, including information educational resources (electronic textbooks, electronic libraries, etc.); preparation for practical work, their design.

Name of sections and topics	Type of independent work (study of educational material, problem solving, abstract, report, test, preparation for the test, exam, etc.)	Volume in hours	Form of control (verification of problem solving, essays, etc.)
<b>Section 1 Principles of functioning of organs and systems</b>			
Theme 1. Introduction. General physiology and biophysics of excitable tissues. Periods of development of the human body. Age peculiarities of the formation and regulation of	Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.	1	Interview, tests, problem solving check.





<p>physiological functions 1. Cell. Its functions. 2. Body tissues (epithelial, connective, muscular and nervous), the main features of their functions. 3. Features of low-excitability connective tissue (connective, bone, cartilage).</p>			
<p>Theme 2. Bioelectric phenomena in living systems. 1. Biopotentials of glandulocytes. The secretory cycle. Topic 2. Physiology of nerve fibers and the nerves conductors. Physiology of muscles. Features of the physiology of nerves and synapses in children. 1. Electroneurography. 2. Physiology of nerve fibers and nerves. 3. The parabiosis (N.E. Vvedensky). 4. Electromyography.</p>	<p>Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.</p>	<p>1</p>	<p>Interview, tests, problem solving check.</p>
<p>Theme 3. General physiology of the CNS. Structure and properties of synapses. 1. The blood-brain barrier. 2. The glia, its function. Methods of research of functions of the central nervous system. 3. The physiological meaning of the doctrine of regulation functions for general medicine and clinical disciplines, to form concepts about health and healthy lifestyle.</p>	<p>Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.</p>	<p>1</p>	<p>Interview, tests, problem solving check.</p>



<p>Theme 4. Inhibition of the nerve centers. Coordination of the reflex activity. 1. Features of processes of excitation and inhibition in children 2. The iconic function of the brain: gnosis, praxis.</p>	<p>Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.</p>	<p>1</p>	<p>Interview, tests, problem solving check.</p>
<p>Theme 5. Physiology of the spinal cord, brainstem and cerebellum. 1. The brain stem.</p>	<p>Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.</p>	<p>1</p>	<p>Interview, tests, problem solving check.</p>
<p>Theme 6. Physiology of the reticular formation 1. Features of neural organization.</p>	<p>Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.</p>	<p>1</p>	<p>Interview, tests, problem solving check.</p>
<p>Theme 7. Physiology of the diencephalon, limbic system and basal nuclei. Physiology of the autonomic nervous system. Features of physiology of the Central nervous system of the developing organism. Features of the autonomic nervous system in children 1. Physiology of limbic system and basal nuclei. 2. The thalamus is a collector of afferent pathways.</p>	<p>Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.</p>	<p>1</p>	<p>Interview, tests, problem solving check.</p>
<p>Theme 8. Methods of evaluating cardiac activity. 1. Ballisto-, echo-, vectorgraphy</p>	<p>Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.</p>	<p>1</p>	<p>Interview, tests, problem solving check.</p>
<p>Theme 9. The</p>	<p>Elaboration of</p>	<p>1</p>	<p>Interview, tests,</p>



<p>regulation of heart activity. 1.Integration of mechanisms regulating the functioning of the heart.</p>	<p>educational material, preparation for the delivery of the colloquium, test and examination.</p>		<p>problem solving check.</p>
<p>Theme 10. The basic laws of hemodynamics 1. Regional circulation. 2. Methodology of the study of organ blood flow (occlusive, plethysmography, ultrasound, and electromagnetic flowmetry). 3. Methods of research of microcirculation. 4. Functional features of the pulmonary circulation, coronary blood flow. 5. Factors of a healthy lifestyle that prevent the disturbance of the blood circulation system. 6. Age features of the circulatory system. 7. Change of organ blood flow during muscular exercise, food intake, pregnancy, hypoxia, stress and other conditions.</p>	<p>Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.</p>	<p>1</p>	<p>Interview, tests, problem solving check.</p>
<p>Theme 11. The lymphatic system, its structure and functions. Features of blood circulation in the fetus and in children. 1. Chylopoesis and mechanisms of its regulation. The factors supplying the flow of lymph and the mechanisms of its regulation.</p>	<p>Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.</p>	<p>1</p>	<p>Interview, tests, problem solving check.</p>



<p>Theme 12. Physiology of breathing. External respiration. The mechanism of inhalation and exhalation. Transport of gases by blood. 1. Transport of gases by blood.</p>	<p>Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.</p>	<p>1</p>	<p>Interview, tests, problem solving check.</p>
<p>Theme 13. Digestion in the intestine. Features of the digestive system in children. 1. The importance of microorganisms and gas in the intestines.</p>	<p>Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.</p>	<p>1</p>	<p>Interview, tests, problem solving check.</p>
<p>Theme 14.1. Thermoregulation. 1. Peculiarities of thermoregulation in children. 2. Temperature-regulation. 3. System mechanisms of thermoregulation and heat transfer. 4. Mechanisms of hardening of the body.</p>	<p>Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.</p>	<p>1</p>	<p>Interview, tests, problem solving check.</p>
<p>Theme 14.2. Metabolism</p>	<p>Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.</p>	<p>1</p>	<p>Interview, tests, problem solving check.</p>
<p>Theme 15. Physiology of the excretion. Features of the excretory system in the fetus and children. 1. Adaptive changes of renal function in different environmental conditions. 2. Skin as an excretory organ. The function of sebaceous and sweat glands, regulation of</p>	<p>Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.</p>	<p>1</p>	<p>Interview, tests, problem solving check.</p>



their activities. Non-excretory function of the skin.			
Theme 16. Physiology of the endocrine glands. 1. Epiphysis. Thymus.	Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.	1	Interview, tests, problem solving check.
Theme 17. Blood physiology. 1. Lymph, its composition, quantity, functions, physiological significance. 2. Extravascular fluid of the body (interstitial, cerebrospinal, synovial, pleural, peritoneal, liquid medium of the eyeball, slime) and their role in supplying the vital activity of body cells. 3. The factors that maintain the integrity of the body. Barriers external and internal environment of the body. Immunity and its types. Theme 17.1. The organism and its protective systems. 1. Protective reflexes.	Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.	1	Interview, tests, problem solving check.
Theme 18. Physiology of analyzers. 1. Acupressure points and the principle of reflexology.	Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.	1	Interview, tests, problem solving check.
<b>Section 2. Functional systems of human organism, their regulation and self-regulation when exposed to the external environment</b>			
Theme 19. The doctrine about functional systems.	Elaboration of educational material, preparation for the	1	Interview, tests



1.System organization of functions.	delivery of the colloquium, test and examination.		
Theme 20. Functional system providing optimal level of metabolism of gases.	Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.	1	Interview, tests, problem solving check.
Theme 21. Functional digestive system and place it in the digestive process.	Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.	1	Interview, tests
Theme 22.1. The organism's adaptation to different conditions of existence. 1. Higher nervous activity in children. Antenatal and neonatal periods 2. Biorythmology (chronobiology). The idea of the discreteness of various processes in the body. Cyclical processes. 3. Physiology of adaptation. Individual adaptation. Types, phases, and criteria of adaptation. Theme 22.2. Purposeful behavior. 1. Purposeful behavior as a form of behavior leading to achieving the body adaptive result. 2. Physiological basis of labour activity. Theme 22.3. The problem of fatigue of the entire organism. 1. Leisure (I. M. Sechenov) and its mechanisms.	Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.	2	Interview, tests





<p>2. Features of physical and mental work. 3. The optimum conditions for work and rest as the basis for a long period of high efficiency of the organism.</p>			
<p>Theme 23. The phenomenon of inhibition of HNA. 1. Types and mechanisms of inhibition of HNA. 2. The physiology of sleep. 3. The physiological basis of hypnotic conditions.</p>	<p>Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.</p>	<p>2</p>	<p>Interview</p>
<p>Theme 24. The types of HNA. The doctrine of 1 and 2 signal systems. Memory. Thinking. Consciousness. Language.</p>	<p>Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.</p>	<p>2</p>	<p>Interview</p>
<p>Theme 25. Reproduction. 1. Reproduction stages. 2. Anatomical and physiological basis of reproduction. 3. The formation and mechanisms of sexual motivation. 4. Phase of the sexual cycle in men. Specificity of phases of the sexual cycle in women.</p>	<p>Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.</p>	<p>2</p>	<p>Interview</p>
<p>Theme 26. Physiology of pain and pain relief. 1. Pain as a sensation and condition. 2. Nociception. Antinociception. 3. Physiological mechanisms of pain and analgesia.</p>	<p>Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.</p>	<p>4</p>	<p>Interview</p>

Theme 27. Practical skills	Elaboration of educational material, preparation for the delivery of the colloquium, test and examination.	2	Interview
Form of knowledge control on the independent study of the subject: a colloquium, credit and exam.			

### Practical skills

For self-study the students are recommended basic and additional educational literature and educational and methodical manuals, published at UISU. Workshop on normal physiology contains various experimental tasks in accordance with all the main sections of the theoretical course and independently performed in the laboratory of the Department of physiology, with laboratory equipment. In this course students solve virtual problem - it is the simulator for independent work.

**Form of control of knowledge** by self-guided study of the subject: **the colloquium, a credit and an examination.**

## 11. LEARNING AND TEACHING RESOURCES OF THE DISCIPLINE.

### a) Recommended literature list principal literature

1 Gening T.P., Abakumova T.V., Mikhailova, Kadyshcheva E.N. Normal physiology. Part I. Physiology of excitable tissues, muscles, CNS, analyzers, HNA. Second Edition Ulyanovsk State University. 2018 104 p. URL: <ftp://10.2.96.134/Text/Gening2018-1.pdf>

2 Gening T.P., Abakumova T.V., Mikhailova, Kadyshcheva E.N. Normal physiology. Part II. Physiology of Cardio-vascular system, Breath, Digestion, Excretion, Endocrine glands, Metabolism and Energy, Blood. Second Edition Ulyanovsk State University. 2018 135 p. URL: <ftp://10.2.96.134/Text/Gening2018-2.pdf>

### additional literature

1. Cardiac Biomechanics in Normal Physiology and Disease/Encyclopedia of Cardiovascular Research and Medicine 2018, Pages 411-419

UPL: <https://www.sciencedirect.com/science/article/pii/B9780128096574110592>

2. Anatomy & Physiology: Current Research - OMICS International

URL: <https://www.omicsonline.org/anatomy-physiology.php>

### educational literature

1. Workshop on normal physiology: methodological guidance for students of medical faculty. / T.P.Gening, T.V.Abakumova, S.O.Gening. – Ulyanovsk: UISU, 2019. – 35 p.

Agreed: Main Librarian of the Scientific Library, Stadolnikova, Comaf, 2021  
The position of an employee of the scientific library      Full name      signature      date

**b) Professed data base, directory and search systems:**

SPS Consultant Plus

The electronic library system IPRBooks

System " Antiplagiat.HIGHER EDUCATIONAL»

"My Office Is Standard"

Clinical Collection: collection for medical universities, clinics, medical libraries //EBSCOhost: [портал]. – URL: <http://web.a.ebscohost.com/ehost/search/advanced?vid=1&sid=e3ddfb99-a1a7-46dd-a6eb-2185f3e0876a%40sessionmgr4008>. – Access mode: for authorization users. - Text: electronic.

SMART Imagebase //EBSCOhost: [портал]. – URL: <https://ebsco.smartimagebase.com/?TOKEN=EBSCO-1a2ff8c55aa76d8229047223a7d6dc9c&custid=s6895741>. – Access mode: for authorization users. -

Image: electronic.

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**12. MATERIAL AND TECHNICAL SUPPORT OF DISCIPLINE LIST OF EQUIPMENT USED AT PRACTICAL ACTIVITIES IN NORMAL PHYSIOLOGY**

Object name, lecture hall	Material support, the availability of logistics, with a list of basic equipment	The address (location) of the object confirming the availability of material and technical support (indicating the number of such an object in accordance with the technical inventory documents)
Classroom 310 for lecture classes, with a set of demonstration equipment to ensure the presentation of illustration material on the discipline in accordance with the work program. The room is equipped with a set of student furniture for 400 seats.	Technical means: 1. Multimedia projector 2. Interactive whiteboard 3. Board classroom 4. Workplace of the teacher	Ulyanovsk 1, Universitetskaya Embankment str., Building 4., room 310
Classroom No. 209 for lecture classes, with a set of demonstration equipment to ensure the presentation of illustration material on the discipline in accordance with the work program. The room is equipped with a set of student furniture for 186 seats.	Technical means: 1. Multimedia projector 2. Interactive whiteboard 3. Board classroom 4. Educational visual aids 5. Workplace of the teacher	Ulyanovsk, 2/1, Arch.Livchak Str., room 209



<p>Classroom number 204 for lectures, practical group (1/2 groups) classes with a set of demonstration equipment to ensure the presentation of illustration material on the discipline in accordance with the work program. The room is equipped with a set of student furniture for 36 seats.</p>	<p>Technical means: 1. Multimedia equipment (TV, laptop) 2. Interactive whiteboard 3. Board classroom 4. Shelving with educational aids 5. Workplace of the teacher 6. The device for electrophysiological research in humans Biopac Student Lab 7. A computer for conducting a virtual workshop on many topics of the course according to the work program 8. 2 working laboratory tables for educational equipment (perimeter, electrocardiograph, etc.) 9. Couch 10. Electric hand dryer 11. Electrical stimulator 12. Fridge 13. Fume hood 14. Curbstones on wheels 15. Laboratory tools (scissors, tweezers, dissecting needles, Galvani forks, pharmacy scales, scalpels, etc.) 16. Computer table 17. Table laboratory washing SLM-1N (ecoline)</p>	<p>Ulyanovsk, 2/1, Arch.Livchak Str., room 204, S=54,97m<sup>2</sup></p>
<p>Classroom number 203 for lectures, practical group (1/2 groups) classes with a set of demonstration equipment to ensure the presentation of illustration material on the discipline in accordance with the work program. The room is equipped with a set of student furniture for 26 seats.</p>	<p>Technical means: 1. Classroom board 2. A stand for educational visual aids 3. Workplace of the teacher 4. A computer for conducting a virtual workshop on many topics of the course according to the work program 5. Apparatus for electrophysiological studies in humans Biopac Student Lab. 6. Computing station for data processing for analysis of PCR results in dir. real time (to Biopac Student Lab) 6. Working laboratory table for</p>	<p>Ulyanovsk, 2/1, Arch.Livchak Str., room 203, S=41,5m<sup>2</sup></p>

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	<p>educational equipment (perimeter, electrocardiograph, etc.)</p> <p>7. Electrical stimulator</p> <p>8. Curbstones on wheels</p> <p>9. Computer table</p> <p>10. A computer for conducting a virtual workshop on many topics of the course according to the work program</p> <p>11 Laboratory tools (scissors, tweezers, dissecting needles, Galvani forks, pharmacy scales, scalpels, etc.)</p>	
<p>Classroom №205 for lectures, practical group (1/2 groups) classes with a set of tables to ensure the presentation of illustration material on the discipline in accordance with the work program.</p> <p>The room is equipped with a set of student furniture for 26 seats.</p>	<p>Technical means:</p> <p>1. Classroom board</p> <p>2. A stand for educational visual aids</p> <p>3. Workplace of the teacher</p> <p>4. A computer for conducting a virtual workshop on many topics of the course according to the work program</p> <p>5. Working laboratory table for educational equipment (perimeter, electrocardiograph, etc.)</p> <p>6. Electrical stimulator</p> <p>7. Curbstones on castors</p> <p>8. Computer table</p> <p>9. Thermostat TS-80</p> <p>10. Distiller DE-4-2M</p> <p>11. Centrifuge TsG-2</p> <p>12 Laboratory tools (scissors, tweezers, dissecting needles, Galvani forks, pharmacy scales, scalpels, etc.)</p> <p>13. Washing laboratory table SLM-1N (ecoline)</p> <p>14. GP-20 sterilizer</p>	<p>Ulyanovsk, 2/1, Arch.Livchak Str., room 205, S=42,5M2</p>

#### LIST OF EQUIPMENT FOR EDUCATIONAL PROCESS

№	Name	Count	Planned to be
1	Electrocardiograph EK – 1	1	1
2	Electrocardiograph one/three-channel EC1T-1/3-07 "Axion"	1	1
3	Electrocardiograph one/three-channel "Axion"	1	1
4	Distiller DE-4-2M	1	1
5	Audiometer	1	1


6	Sterilizer GP-20	1	1
7	Fridge	2	2
8	Centrifuge OPN-8	1	1
9	The stereotactic radiotherapy SEG-5	1	1
10	Centrifuge hematocrit. TT-2	-	2
11	Microscope Lumam	1	1
12	The stereoscopic microscope Leica EZ40	1	2
13	The microscope MICMED	2	2
14	Electrostimulator SP-01-AP	3	3
15	Recorder type H-3031 – 1 channel	2	2
16	A set of pipette	8	8
17	Neurological hammer	3	4
18	Spring clips – serpinas	10	10
19	The Engelmann's levers	4	4
20	Scales VK 150,1 (from 0.005 to 150 g)	1	1
21	Libra pharmacy	4	4
22	The weights from 1 mg to 500 g	1	4
23	Mechanic tonometer LD-71	6	6
24	Water thermometer	2	2
25	Phonendoscope	10	10
26	The forked electrodes	4	4
27	Polygraph for electrophysiological studies MF30 (Biopac Student Lab), expanded.	1	1
28	Hardware-software program complex "Valenta" for research	1	1
29	"Neyrovizor" system for registration and analysis of EEG, evoked potentials and physiological parameters	1	1
30	TV Daewoo 20Q3M	1	1
31	Videoplayer	1	1
32	DVD-player United 7062	4	4

### LIST OF VIDEOS ON NORMAL PHYSIOLOGY

The autonomic nervous system - 1 part.  
 Higher nervous activity. Types of GNI. - 4 parts.  
 Analyzers (auditory, gustatory). - 2 parts.  
 Compensatory and adaptive function. - 2 parts.  
 Renal excretory function - 1 part.  
 Bladder dysfunction. - 2 parts.  
 Blood cells. - 2 parts.  
 Thermoregulation - 1 part.  
 Adaptation of the organism. - 2 parts.  
 Transfer of blood gases. - 1 part.  
 Hormones - 1 part.

### 13. SPECIAL CONDITIONS FOR STUDENTS WITH DISABILITIES OF HEALTH



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If necessary, students from among persons with disabilities (at the request of the student) may be offered one of the following options for perceiving information, taking into account their individual psychophysical characteristics:


- for persons with visual impairment: in print in large print; in the form of an electronic document; in the form of an audio file (translation of training materials into audio format); in printed form in Braille; individual consultations with the involvement of a tiflos sign language interpreter; individual tasks and consultations;


- for persons with hearing impairment: in printed form; in the form of an electronic document; video materials with subtitles; individual consultations involving an interpreter; individual tasks and consultations;

- for persons with disorders of the musculoskeletal system: in print; in the form of an electronic document; in the form of an audio file; individual tasks and consultations.

If it is necessary to use partially / exclusively distance educational technologies in the educational process, the organization of work of the teaching staff with students with disabilities and disabled people is provided in the electronic information and educational environment, taking into account their individual psychophysical characteristics.


Developer  Head of Department Tatyana P. Gening  
Signature position name

Developer  Docent Tatyana V. Abakumova  
Signature position name

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**Approval sheet of the Discipline "Normal Physiology" Specialty 31.05.01. "General Medicine"**

<b>№</b>	<b>Content of change or link to attached text</b>	<b>Full name of the head of the department implementing the discipline / graduating department</b>	<b>Signature</b>	<b>Date</b>
<b>1</b>	Appendix 1. Amendments to p.p. a) List of recommended literature p. 11 "Educational, methodological and information support of the discipline / practice" with the execution of a separate application	Gening T.P.		29.08.2022
<b>2</b>	Appendix 2. Amendments to p.p. b) Professional databases clause 11 "Educational, methodological and information support of discipline / practice" with the execution of a separate application	Gening T.P.		29.08.2022

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Appendix 1

## 11. EDUCATIONAL-METHODICAL AND INFORMATION SUPPORT OF DISCIPLINE

### a) List of recommended literature

#### principal literature

1. Normal physiology : education guidance for students of medical faculty. Part 2. Physiology of Cardio-vascular system, Breath, Digestion, Excretion, Endocrine glands, Metabolism and Energy, Blood / Т. Р. Gening, Т. V. Abakumova, N. L. Mikhailova, E. N. Kadysheva ; Ulyanovsk State University, Insitute of Medicine, Ecology and Physical culture. - 2nd ed. - Электрон. текстовые дан. (1 файл : 5,55 Мб). - Ulyanovsk : ULSU, 2018. - Текст на англ. яз. - Загл. с экрана. - Текст : электронный.  
<http://lib.ulsu.ru/MegaPro/Download/MObject/1202>

2. Лапкин, М. М. Избранные лекции по нормальной физиологии = Selected Lectures on Normal Physiology : учебное пособие на русском и английском языках / М. М. Лапкин, Е. А. Трутнева. - Москва : ГЭОТАР-Медиа, 2021. - 544 с. - ISBN 978-5-9704-5972-0. - Текст : электронный // ЭБС "Консультант студента" : [сайт]. - URL : <https://www.studentlibrary.ru/book/ISBN9785970459720.html>

#### additional literature

1. Gening Т.Р. Workshop on physiology of visceral system : methodological guidance for students of medical faculty / Т. Р. Gening, Т. V. Abakumova, S. O. Gening. - Ulyanovsk : UISU, 2021. - 25 р. - На англ. яз.; Неопубликованный ресурс. - URL: <http://lib.ulsu.ru/MegaPro/Download/MObject/10560>. - Режим доступа: ЭБС УлГУ. - Текст : электронный.

2. Gening Т.Р. Physiology of visceral systems : Education guidance for students of medical faculty / Т. Р. Gening, Т. V. Abakumova. - Ulyanovsk : UISU, 2019. - На англ. яз.; Загл. с экрана; Неопубликованный ресурс. - Электрон. текстовые дан. (1 файл : 1,46 Мб). - URL: <http://lib.ulsu.ru/MegaPro/Download/MObject/1929>. - Режим доступа: ЭБС УлГУ. - Текст : электронный.

#### educational literature

1. Gening Т.Р. Methodical instructions for organizing independent work of students in the discipline «Physiology of visceral system» / Т. Р. Gening, Т. V. Abakumova, S. O. Gening. - Ulyanovsk : UISU, 2021. - 7 р. - На англ. яз.; Неопубликованный ресурс. - URL: <http://lib.ulsu.ru/MegaPro/Download/MObject/10567>. - Режим доступа: ЭБС УлГУ. - Текст : электронный.

AGREED:

*Main Librarian*

The position of an employee  
of the scientific library

*Старолюбовас*

Full name


*Стар*

signature

*12.05.2022*

date



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## **в) Профессиональные базы данных, информационно-справочные системы**

### **1. Электронно-библиотечные системы:**

1.1. Цифровой образовательный ресурс IPRsmart : электронно-библиотечная система : сайт / ООО Компания «Ай Пи Ар Медиа». - Саратов, [2022]. – URL: <http://www.iprbookshop.ru>. – Режим доступа: для зарегистрир. пользователей. - Текст : электронный.

1.2. Образовательная платформа ЮРАЙТ : образовательный ресурс, электронная библиотека : сайт / ООО Электронное издательство ЮРАЙТ. – Москва, [2022]. - URL: <https://ura.it.ru>. – Режим доступа: для зарегистрир. пользователей. - Текст : электронный.

1.3. База данных «Электронная библиотека технического ВУЗа (ЭБС «Консультант студента») : электронно-библиотечная система : сайт / ООО Политехресурс. – Москва, [2022]. – URL: <https://www.studentlibrary.ru/cgi-bin/mb4x>. – Режим доступа: для зарегистрир. пользователей. – Текст : электронный.

1.4. Консультант врача. Электронная медицинская библиотека : база данных : сайт / ООО Высшая школа организации и управления здравоохранением-Комплексный медицинский консалтинг. – Москва, [2022]. – URL: <https://www.rosmedlib.ru>. – Режим доступа: для зарегистрир. пользователей. – Текст : электронный.

1.5. Большая медицинская библиотека : электронно-библиотечная система : сайт / ООО Букап. – Томск, [2022]. – URL: <https://www.books-up.ru/ru/library/>. – Режим доступа: для зарегистрир. пользователей. – Текст : электронный.

1.6. ЭБС Лань : электронно-библиотечная система : сайт / ООО ЭБС Лань. – Санкт-Петербург, [2022]. – URL: <https://e.lanbook.com>. – Режим доступа: для зарегистрир. пользователей. – Текст : электронный.

1.7. ЭБС Znanium.com : электронно-библиотечная система : сайт / ООО Знаниум. - Москва, [2022]. - URL: <http://znanium.com>. – Режим доступа : для зарегистрир. пользователей. - Текст : электронный.

1.8. Clinical Collection : научно-информационная база данных EBSCO // EBSCOhost : [портал]. – URL: <http://web.b.ebscohost.com/ehost/search/advanced?vid=1&sid=9f57a3e1-1191-414b-8763-e97828f9f7e1%40sessionmgr102>. – Режим доступа : для авториз. пользователей. – Текст : электронный.

1.9. База данных «Русский как иностранный» : электронно-образовательный ресурс для иностранных студентов : сайт / ООО Компания «Ай Пи Ар Медиа». – Саратов, [2022]. – URL: <https://tos-edu.ru>. – Режим доступа: для зарегистрир. пользователей. – Текст : электронный.

**2. КонсультантПлюс** [Электронный ресурс]: справочная правовая система. /ООО «Консультант Плюс» - Электрон. дан. - Москва : КонсультантПлюс, [2022].


### **3. Базы данных периодических изданий:**

3.1. База данных периодических изданий EastView : электронные журналы / ООО ИВИС. - Москва, [2022]. – URL: <https://dlib.eastview.com/browse/udb/12>. – Режим доступа : для авториз. пользователей. – Текст : электронный.

3.2. eLIBRARY.RU: научная электронная библиотека : сайт / ООО Научная Электронная Библиотека. – Москва, [2022]. – URL: <http://elibrary.ru>. – Режим доступа : для авториз. пользователей. – Текст : электронный

3.3. Электронная библиотека «Издательского дома «Гребенников» (Grebinnikon) : электронная библиотека / ООО ИД Гребенников. – Москва, [2022]. – URL: <https://id2.action-media.ru/Personal/Products>. – Режим доступа : для авториз. пользователей. – Текст : электронный.

**4. Федеральная государственная информационная система «Национальная электронная библиотека»** : электронная библиотека : сайт / ФГБУ РГБ. – Москва, [2022].

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– URL: <https://нрб.рф>. – Режим доступа : для пользователей научной библиотеки. – Текст : электронный.

**5. SMART Imagebase** : научно-информационная база данных EBSCO // EBSCOhost : [портал].  
– URL : <https://ebSCO.smartimagebase.com/?TOKEN=EBSCO-1a2ff8c55aa76d8229047223a7d6dc9c&custid=s6895741>. – Режим доступа : для авториз. пользователей. – Изображение : электронные.

**6. Федеральные информационно-образовательные порталы:**

6.1. Единое окно доступа к образовательным ресурсам : федеральный портал . – URL: <http://window.edu.ru/> . – Текст : электронный.

6.2. Российское образование : федеральный портал / учредитель ФГАУ «ФИЦТО». – URL: <http://www.edu.ru>. – Текст : электронный.

**7. Образовательные ресурсы УлГУ:**

7.1. Электронная библиотечная система УлГУ : модуль «Электронная библиотека» АБИС Мега-ПРО / ООО «Дата Экспресс». – URL: <http://lib.ulsu.ru/MegaPro/Web>. – Режим доступа : для пользователей научной библиотеки. – Текст : электронный.

СОГЛАСОВАНО:

Зам. рек. УлГУ  
Должность

Ключева ОВ  
ФИО

[Подпись]  
подпись

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