BOGOMOLETS NATIONAL MEDICAL UNIVERSITY
Educational and scientific Institute of medicine
Department of Physiology

APPROVED
Vice-Rector of the Higher Education Institution Bogomolets National Medical University for Scientific, Pedagogical, and Academic Affairs,
Doctor of Medical Sciences, Professor
Oleh VLASENKO

WORKING PROGRAM OF THE EDUCATIONAL DISCIPLINE
HOMEOSTASIS AND ITS REGULATION

Educational level	second (master's)
Discipline	And "Healthcare and Social Security"
Specialty	12 "Medicine"
Educational program	Educational and professional program "Medicine" of the second (master's) level of higher education in specialty 12 "Medicine"

2026 – 2027 academic year

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Working program of the academic discipline EC 2.10 " Homeostasis and its regulation " for students in the direction of training specialists of the second (master's) level, specialty "I2 Medicine" of full-time study.

Program developers: Acting Head of the Department, Candidate of Biological Sciences, Associate Professor Vynohradova -Anyk O.O., Associate Professor, Candidate of Medical Sciences Tarasova K.V., Associate Professor, Candidate of Medical Sciences Karvatsky I.M.

The work program was discussed and approved at the methodological meeting of the Department of Physiology

Minutes No. 147/26 of " 26 " August 2026 years.

The work program was approved at a meeting of the Cyclic Methodological Commission for Natural Sciences

Protocol No. 1 of " 26 " August 2026

Acting Head of the Department of Physiology,
Candidate of Biological Sciences ,
Associate Professor O.O. Vynohradova-Anyk

Head of the Cyclic Methodological Commission
in Natural Sciences, Candidate of Biological Sciences ,
Associate Professor L.V. Yanitska

Guarantor of the educational (educational and professional) program
Doctor of Medicine , Professor, V.S. Melnyk

Head of the Department of Educational and Methodological Work,
licensing and accreditation, PhD , Associate Professor I.I. Kucherenko

1. Description of the elective discipline «Homeostasis and its regulation»

<table>
<tr><td rowspan="2">Name of indicators</td><td rowspan="2">Field of knowledge, specialty, educational level</td><td colspan="2">Characteristics of the academic discipline</td></tr>
<tr><td>full-time education</td><td>correspondence form of study</td></tr>
<tr><td>Number of credits – 3.0</td><td>Discipline
22 “Healthcare”
(code and name)</td><td colspan="2">By choice</td></tr>
<tr><td>Modules – 1</td><td rowspan="5">Specialty
222 “Medicine”
(code and name)</td><td colspan="2">Year of preparation</td></tr>
<tr><td>Content modules – 2</td><td>2nd</td><td></td></tr>
<tr><td>Individual research task
_____
(name)</td><td colspan="2">Semester</td></tr>
<tr><td rowspan="2">Total credits/hours – 3.0/90</td><td>IV-th</td><td></td></tr>
<tr><td colspan="2">Lectures</td></tr>
<tr><td rowspan="11">Weekly hours for full-time study:
classrooms – 1.6
student's independent work – 3.1</td><td rowspan="11">Educational level
“Master”</td><td>6 hours.</td><td></td></tr>
<tr><td colspan="2">Practical, seminar</td></tr>
<tr><td>20 hours.</td><td></td></tr>
<tr><td colspan="2">Laboratory</td></tr>
<tr><td>- hour.</td><td></td></tr>
<tr><td colspan="2">Independent work</td></tr>
<tr><td>60 hours.</td><td></td></tr>
<tr><td colspan="2">Individual tasks:</td></tr>
<tr><td colspan="2">11 a.m.</td></tr>
<tr><td colspan="2">Type of control:</td></tr>
<tr><td>differential balance</td><td>test</td></tr>
</table>

Note.
The ratio of the number of hours of classroom lessons to independent and individual work for full-time study is: classroom load – 33%, SRS – 67%

2. Purpose, expected learning outcomes and criteria for assessing learning outcomes
2.1. The purpose of teaching the academic discipline “ Homeostasis and its regulation ” is the study of mechanisms and patterns of maintaining the physiological parameters of the internal environment of the organism in the process of vital activity, the study of mechanisms of regulation and autoregulation of homeostasis constants in order to use the knowledge gained in the study of subsequent medical disciplines and in future professional activities. The academic discipline lays the foundations for understanding the concept of health, a healthy lifestyle and prevention of dysfunction in the process of vital activity.

The final goals are set on the basis of the EPP of training a doctor by specialty in accordance with the block of its content module (natural science training) and are the basis for building the content of the academic discipline. The description of the goals is formulated through skills in the form of target tasks (actions). Based on the final goals , ***specific goals are formulated for each module or content module*** in the form of certain skills (actions), target tasks that ensure the achievement of the final goal of studying the discipline.

Ultimate goals of the discipline

- *To draw conclusions about the state of the physiological functions of the body, its systems and organs*
- *Analyze regulated parameters and draw conclusions about the mechanisms of nervous and humoral regulation of physiological functions of the body and its systems*
- *Analyze human health under different conditions based on physiological criteria*
- *Interpret the mechanisms and patterns of functioning of the body's excitable structures*
- *Analyze the state of sensory processes in ensuring human life*
- *Explain the physiological foundations of methods for studying body functions*
- *Understand the principles of homeostatic mechanisms in the body and be able to diagnose them*
- *Apply physiological research methods, modern digital technologies and devices to study problems of homeostasis physiology within the framework of professional activities*
- *Construct models of phenomena and processes that characterize homeostatic mechanisms, predict the consequences of relevant environmental influences on homeostasis*
- *Explain the mechanisms of integrative activity of the organism.*

2.2. The main objectives of studying the discipline " Homeostasis and its regulation" as a science is a systematic approach to studying the essence of physiological processes, functions of individual organs, systems and the whole organism. Study of nervous and endocrine regulation of the activity of the organism, its organs and systems. Disclosure of physiological mechanisms of interaction of organs and systems. Study of mechanisms of pharmacological correction of physiological processes of the organism. Formation of practical skills in students of determining and assessing the functional features of the organism. Expansion of the idea of the role of studying human physiology for mastering other medical disciplines.

2.3 Competencies and learning outcomes, the formation of which is facilitated by the discipline (relationship with the normative content of training for higher education applicants, formulated in terms of learning outcomes in the Standard).

According to the requirements of the standard, the discipline ensures that students acquire ***the following competencies*** **:**

Integral:

Integral competenceAbility to solve complex problems, including those of a research and innovation nature in the field of medicine. Ability to continue learning with a high degree of autonomy.*General competencies (GC):*

GC 1. GC1. Ability for abstract thinking, analysis and synthesis.

GC 2. Ability to learn and master modern knowledge.

GC 3. Ability to apply knowledge in practical situations.

GC 4. Knowledge and understanding of the subject area and understanding of professional activity.

GC 5. Ability to adapt and act in a new situation.

GC 6. Ability to make informed decisions.

GC 7. Ability to work in a team.

GC 8. Ability for interpersonal interaction.

GC 9. Ability to communicate in a foreign language.

GC 10. Ability to use information and communication technologies.

GC 11. Ability to search, process and analyze information from various sources.

GC 12. Determination and persistence in achieving goals

GC 13. Awareness of equal opportunities and gender issues.

GC 14. The ability to exercise one's rights and obligations as a member of society, to realize the values of a civil (free democratic) society and the need for its sustainable development, the rule of law, and the rights and freedoms of man and citizen in Ukraine.

GC 15. The ability to preserve and multiply moral, cultural, scientific values and achievements of society based on understanding the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, technology and engineering, to use various types and forms of physical activity for active recreation and leading a healthy lifestyle.

Special (professional, subject) competencies (PC):

PC 21. Clearly and unambiguously communicate one's own knowledge, conclusions, and arguments on health care problems and related issues to specialists and non-specialists, including students .

PC 23. Ability to develop and implement scientific and applied projects in the field of healthcare.

PC 24. Compliance with ethical principles when working with patients and laboratory animals.

PC 25. Adherence to professional and academic integrity, responsibility for the reliability of the obtained scientific results.

Program Learning Outcomes (PLO):

PLO 1. Have a thorough knowledge of the structure of professional activity. Be able to carry out professional activities that require updating and integration knowledge. Be responsible for professional development, ability to further professional training with a high level of autonomy.PLO 2. Understanding and knowledge of basic and clinical biomedical sciences, including level sufficient to solve professional tasks in the field of securityhealth.

PLO 3. Specialized conceptual knowledge that includes scientific achievements in the field of health care and is the basis for conducting research, critical understanding of problems in the

field of medicine and related interdisciplinary problems, including the system of early intervention.
PLO 4. Highlight and identify the leading clinical symptoms and syndromes (list 1);
According to standard methods, using preliminary data from the patient's history, patient examination data, knowledge about the person, his organs and systems, establish a preliminary clinical diagnosis of the disease (according to list 2).
PLO 5. Collect complaints, life and disease history, assess the patient's psychomotor and physical development, the condition of organs and body systems, and based on the results of laboratory and instrumental studies, evaluate information regarding the diagnosis (according to list 4), taking into account the patient's age.
PLO 6. Establish a final clinical diagnosis by making a reasoned decision and analyzing the obtained subjective and objective data of clinical, additional examination, conducting differential diagnostics, adhering to relevant ethical and legal norms, under the supervision of the head physician in a healthcare facility (according to list 2).
PLO 8. Determine the main clinical syndrome or what determines the severity of the victim's condition (according to list 3) by making a reasoned decision and assessing the person's condition under any circumstances (in a healthcare facility, outside it), including in emergency situations and combat operations, in field conditions, in conditions of lack of information and limited time.
PLO 9. Determine the nature and principles of treatment of patients (conservative, surgical) with diseases (according to list 2), taking into account the patient's age, in the conditions of a healthcare institution, outside it and at the stages of medical evacuation, including in field conditions, based on a preliminary clinical diagnosis, adhering to relevant ethical and legal norms, by making a reasoned decision according to existing algorithms and standard schemes, if necessary, expand the standard scheme, be able to substantiate personalized recommendations under the supervision of the head physician in the conditions of a medical institution.
PLO 13 Assess and monitor child development, provide recommendations
on feeding and nutritional characteristics depending on age, organize preventive vaccinations according to the calendar.

2.3. Competency matrix :

	GC	PC		PLO	PLO	PLO
EC 2.10.	1-15	2 1	23-25	1-6	8.9	13

Criteria for evaluating learning outcomes.

The assessment of students' academic performance is regulated by the Regulations on the "Procedure for assessing students' knowledge during current and final discipline control at the O.O. Bogomolets National Medical University" (minutes of the meeting of

the Academic Council of the O.O. Bogomolets National Medical University No. 4 dated 11/28/2023).

The Department of Physiology has approved criteria for assessing student learning outcomes, a detailed description of which is provided below.

3. **The discipline program is structured into 1 module , which includes 3 content modules:**

Module 1. " Homeostasis and its regulation ".

Content modules:

1. Principles of nervous and humoral regulation of homeostasis parameters.

2. The role of visceral systems in ensuring homeostasis.

The volume of students' academic workload is described in ECTS credits, which are credited to students if they successfully complete the corresponding module (credit).

The credit transfer system of organizing the educational process requires students to conscientiously and systematically study the discipline throughout the academic year.

The types of students' educational activities according to the curriculum are: a) lectures, b) practical classes, c) independent work of students (IW). Thematic plans of lectures, practical classes, IW ensure the implementation in the educational process of all topics that are part of the content modules.

The topics of the lecture course reveal problematic issues of the relevant sections of physiology.

Practical classes include:

1) research by students of functions in experiments on animals, isolated organs, cells, models or based on experiments recorded in videos, films, presented in computer programs and other educational technologies;

2) solving situational problems (assessment and analysis of function indicators, homeostasis parameters, regulatory mechanisms, etc.) that have an experimental or clinical-physiological focus.

Duration of practical session – 2 academic hours (2 * 45 minutes)

The student's educational activity is assessed at each stage of the practical session, and the overall assessment is comprehensive.

During practical classes, students briefly write down protocols of the research they conducted, indicating the topic of the class, the purpose of the research, the progress of the work or the name of the method, the results and conclusions of the research, answers to situational tasks, etc.

Students' current academic activities are monitored in practical classes according to specific goals.

The following means of diagnosing the level of students' training are used: computer tests, solving situational problems, conducting laboratory tests and interpreting and evaluating their results, analyzing and evaluating the results of instrumental studies and parameters that characterize the functions of the human body, its systems and organs; controlling practical skills, and others.

Upon completion of the study of one or more content sections, ***an intermediate control is carried out*** (*control lesson, practical skills*) to identify the level of students' assimilation of the material covered by test control methods, solving situational problems, writing ***test papers*** , etc.

An important form of student learning is ***independent work .*** Students perform independent work during preparation for classes, and also work on topics that are not included in the thematic plan of practical classes. In the organization of VTS, consultations by teachers play a large role. VTS is controlled by the teacher during practical classes and during intermediate and final control.

After completing each module, ***a final test (exam) is conducted.***

The assessment of a student's performance in the discipline is rating, it is given on a multi-point scale **and is determined by the ECTS system and the traditional scale adopted in Ukraine.**

Information volume of the academic discipline

90 hours of 3.0 ECTS credits are allocated for studying the academic discipline .

Description of the curriculum for the discipline " Homeostasis and its regulation " for students of medical faculties, specialty 222 "Medicine"

Structure of the academic discipline	Number of hours, of which				Year of study	Type of control
	Total	Auditorium		CRC		
		Lectures	Practical classes			
	90	**6**	**20**	**60**	**2nd**	**Final exam (differential exam)**
ECTS credits	**3.0**					
" Homeostasis and its regulation": *Content modules 2*	**90 hours / 3.0 ECTS** credits	**6**	**20**	**60**		
Weekly workload	*4.7 hours / 0.16 ECTS credits*					

Note : 1 ECTS credit – 30 hours.

The ratio of the number of hours of classroom lessons to independent and individual work for full-time study is: classroom load – 33%, SRS – 67%

4. Academic discipline program

Module 1. " Homeostasis and its regulation"

Content module 1. Principles of nervous and humoral regulation of homeostasis parameters.

Specific objectives:

- *Explain the mechanisms of transport of substances through cell membranes and the role of these processes in ensuring physiological functions*
- *Analyze changes in the transport function of cell membranes and their regulatory mechanisms.*
- *Explain the mechanisms of development and propagation of membrane potentials and the role of these processes in ensuring physiological functions;*
- *To analyze the influence of changes in the composition of extracellular fluid on the parameters of membrane potentials, the speed of their conduction in ensuring the physiological functions of nerve and muscle fibers*
- *Explain the mechanisms of contraction and relaxation of skeletal, cardiac, and smooth muscle fibers and the role of regulatory mechanisms in ensuring them*
- *Interpret the emergence, physiological mechanisms and dynamics of changes in the functioning of excitable cells and tissues as a consequence of changes in homeostasis indicators*
- *Describe the mechanisms of reflex regulation of functions and the role of the links of the reflex arc as components of the biological regulation circuit in ensuring the constancy of the internal environment of the organism*
- *Analyze the principles of reflex coordination with the participation of the corresponding neural circuits in ensuring the adaptive response of the body*
- *Analyze the role of the autonomic nervous system in ensuring the systemic activity of the body*
- *Analyze the principles of humoral regulation of homeostasis parameters*
- *Draw conclusions about the state of the physiological functions of the body, its systems and organs when the concentration of hormones in the body changes*
- *To analyze the nature of the relationship between the nervous and humoral regulatory systems during the implementation of homeostatic mechanisms*

Topic 1. Study of the influence of changes in homeostasis parameters on the functioning of excitable tissues.

Modern understanding of the structure and function of cell membranes.

Membrane proteins: receptor proteins, ion channel proteins, transport proteins, pump proteins. Transport of lipophilic and hydrophilic substances through membranes. Dependence of solubility of substances in lipids on pH of the medium. Features of solubility of medicinal substances in lipids and its use in therapy.

Passive transport of substances through ion channels, their permeability, selectivity, channel gates as mechanisms for regulating their permeability. Types of passive transport, factors that determine them.

Transport of ions through membranes. Ion channels of membranes, their types, functions. Ion pumps of membranes, their functions. Ion gradients of the cell – ionic asymmetry. Receptors of membranes, their functions.

Active transport of substances, its types. Primary active transport, its energy supply.

The role of sodium-potassium pumps in the transport of sodium and potassium ions, in the regulation of intracellular water volume. The electrogenic nature of the sodium-

potassium pump. The role of calcium pumps in the transport of calcium ions through cell membranes, the sarcoplasmic reticulum, and mitochondria.

Secondary active transport and its connection with primary active transport to create a concentration gradient of substances on both sides of the cell membrane. Types of secondary active transport of substances: a) symport ; b) antiport .

Exocytosis , its role in the transport of substances synthesized in the cell. Exocytosis neurotransmitters through the presynaptic membrane in synapses. Endocytosis , its types and role in transporting substances into the cell.

Cellular homeostasis. Mechanisms of maintaining homeostasis at the tissue level.

Irritability, excitability as the basis of tissue response to irritation. Depolarization threshold as an indicator of the level of excitability.

Resting membrane potential : mechanisms of origin, parameters, physiological role of the PS.

Action potential (AP): mechanisms of origin, phases, parameters, physiological role.

Changes in cell excitability during the development of PD. Periods of absolute and relative refractoriness , mechanisms of their origin, physiological significance.

Physiological properties of nerve fibers. Mechanisms of nerve impulse conduction by myelinated and unmyelinated nerve fibers. Patterns of excitation conduction. Speed of excitation conduction, factors on which it depends. Characteristics of nerve fibers of type A, B, C.

Neuromuscular synapse, its structure, functions. Mechanisms of chemical transmission of excitation through the neuromuscular synapse. End plate potential (EPP). Physiological mechanisms of blockade of neuromuscular transmission.

Mechanisms of contraction and relaxation of skeletal muscles. Mechanisms of the combination of excitation and contraction in muscle fibers.

Types of muscle contraction depending on the frequency of stimulation: single, tetanic. Properties of muscles in the body. Motor units. Energetics of muscle contraction.

Membrane potentials of smooth muscles. Types of smooth muscles. Processes of coupling of excitation and contraction. Contractile proteins. Molecular basis of muscle contraction and relaxation. The role of calcium ions and calmodulin in the regulation of the force of contraction, sources of calcium ions.

Mechanisms of contraction and relaxation of skeletal, cardiac and smooth muscle fibers and the role of regulatory mechanisms in their provision. Features of changes in membrane potentials and specific functions of excitable cells (nerve, muscle, secretory) in the event of changes in the composition and (or) properties of the extracellular fluid (excess or deficiency of ions, temperature change, etc.).

Topic 2. Study of the influence of various factors on homeostasis parameters. Nervous and humoral mechanisms regulations homeostasis .

The impact of prolonged and (or) intense physical exertion as a stress factor on homeostasis parameters.

The impact of prolonged (in particular protein) starvation as a stress factor on homeostasis parameters.

The effect of water restriction as a stress factor on homeostasis parameters.

The effect of prolonged exposure to high altitudes on homeostasis parameters.

The impact of blood loss (for example, given small intervals between blood donation episodes in healthy people) on homeostasis parameters.

The effect of prolonged exposure to high and low environmental temperatures on homeostasis parameters.

Principles of nervous and humoral regulatory mechanisms that counteract the disruption of homeostasis under the influence of various factors on the body of a healthy adult.

Content module 2. The role of visceral systems in ensuring homeostasis.

Specific objectives:

- *Interpret the importance of compensatory mechanisms in maintaining homeostasis.*
- *Interpret the importance of regulatory systems in compensation processes.*
- *Analyze the functions of the blood system as a condition for ensuring homeostasis.*
- *Analyze the functions of the circulatory system as a condition for ensuring homeostasis.*
- *Analyze the functions of the respiratory system as a condition for ensuring homeostasis.*
- *Analyze the functions of the system regulating nutrient homeostasis in the body*
- *Analyze the mechanisms of regulation of hunger and satiety as a condition for ensuring homeostasis.*
- *Analyze the mechanisms of energy metabolism regulation as a condition for ensuring homeostasis.*
- *Analyze the functions of the thermoregulation system as a condition for ensuring homeostasis.*
- *Analyze the functions of the excretory system as a condition for ensuring homeostasis.*

Topic 3. Research into the mechanisms of regulation of blood PO_2

Functions of blood, its physicochemical properties. Types and compounds of hemoglobin. Regulation of erythropoiesis . Oxygen capacity of blood.

Structure and functions of the respiratory system. The importance of breathing for the body. The main stages of the respiratory process. Mechanisms of oxygen exchange between inhaled air and alveolar gas mixture, between alveoli and blood in pulmonary capillaries. Relationship between pulmonary circulation and lung ventilation. The role of the reaction of pulmonary vessels to a decrease in blood PO_2. Physiology of erythrocytes. Regulation of erythropoiesis . Transport of oxygen by blood. Mechanisms of oxygen exchange between arterial blood and tissues. Oxyhemoglobin dissociation curve and factors influencing its course. Regulation of respiration at low oxygen content in atmospheric air. Mechanisms underlying the response of sensory cells – chemoreceptors

to hypoxemia . Effect of hypoxemia on cardiac activity and vascular tone. Role of visceral systems in adaptation to hypoxia.

Topic 4. Research into the mechanisms of regulation of RSO $_2$ blood

The value of the constancy of carbon dioxide tension in arterial blood as a parameter of homeostasis.

Mechanisms underlying the response of sensory cells – chemoreceptors to hypercapnia .

Exchange of CO_2 between venous blood and alveolar gas mixture. Forms of transportation CO_2 in the blood. The effect of blood PCO_2 on oxyhemoglobin dissociation.
Regulation of breathing at elevated levels of carbon dioxide in atmospheric air.
The effect of hypercapnia on cardiac activity and vascular tone.
The role of visceral systems (blood, circulation, respiration, excretion) in the regulation of blood PCO_2.

Topic 5. Research into the mechanisms of blood pH regulation

hydrogen ion concentration constancy as a parameter of homeostasis.
Mechanisms underlying the response of sensory cells – chemoreceptors – to the concentration of hydrogen ions in the blood.
Blood pH and physicochemical mechanisms for maintaining it at a constant level. The role of buffer systems.
Effect of blood pH on oxyhemoglobin dissociation.
Types and causes of acid-base imbalance.
The role of visceral systems (blood, circulation, respiration, excretion) in regulating blood pH .

Topic 6. Research into the mechanisms of regulation of total blood osmotic pressure

Physiological significance of the constancy of the total osmotic pressure of blood as a parameter of homeostasis.
Components of blood plasma that participate in creating overall osmotic pressure.
Mechanisms underlying the response of sensory cells – chemoreceptors to increased osmotic extracellular fluid.
Types and causes of changes in blood osmotic pressure
The role of visceral systems (digestion, blood, circulation, excretion) in the regulation of total osmotic pressure

Topic 7. Research into the mechanisms of regulation of blood oncotic pressure

Physiological significance of the constancy of blood oncotic pressure as a parameter of homeostasis.

Components of blood plasma involved in creating oncotic pressure .

The role of the liver in creating blood oncotic pressure.

Modern views on the mechanisms of regulation of blood plasma oncotic pressure.

Types and causes of changes in blood oncotic pressure

The role of visceral systems (digestion, blood, circulation, excretion) in providing oncotic

pressure.

Topic 8. Research into the mechanisms of regulation of circulating blood volume

Physiological significance of the constancy of circulating blood volume as a parameter homeostasis. Components of the blood and vascular bed involved in ensuring the constancy of BCC. The role of the kidneys in the long-term regulation of circulating blood volume. Hormonal mechanisms of BCC regulation (renin -angiotensin -aldosterone system, vasopressin, natriuretic peptides). Modern views on neurohumoral mechanisms of BCC control. Varieties and causes of changes in circulating blood volume (hypovolemia , hypervolemia). The role of visceral systems (circulation, excretion, digestion, endocrine system) in ensuring the constancy of BCC.

Topic 9. Research into the mechanisms of regulation of the concentration of sodium and potassium ions in the blood

Physiological significance of the constancy of the concentration of sodium and potassium ions in the blood as parameters of homeostasis.

Mechanisms of absorption of sodium and potassium ions in the digestive tract.

The role of the kidneys in excretion processes, mechanisms of urine formation.

The main processes of urine formation: filtration, reabsorption, secretion. Filtration mechanisms, composition

primary urine. Regulation of filtration rate. Reabsorption of sodium and secretion of potassium in the tubules, its

mechanisms.

Regulation of urine formation. The role of the kidneys in maintaining isoionization. Humoral mechanisms of regulation of participation

kidneys in maintaining the concentration of sodium and potassium ions in the blood: mechanisms of secretion regulation

aldosterone and atrial natriuretic hormones.

Topic 10. Research into the mechanisms of regulation of calcium ion concentration in the blood

Physiological significance of the constancy of calcium ion concentration in the blood as a parameter of homeostasis.

Mechanisms of calcium ion absorption in the digestive tract and their regulation.

Types and causes of changes in the concentration of calcium ions in the blood

Regulation of urine formation. The role of the kidneys in maintaining isoionization. Humoral mechanisms of regulation of participation

kidneys in maintaining a constant concentration of calcium ions in the blood: mechanisms of action of parathormone ,

thyrocalcitonin , calcitriol .

Structure of the academic discipline

Names of content modules and topics	Number of hours					
	day uniform					
	total	including				
		l	n	seven	ind	s.r.
1	2	3	4	5	6	7
Module 1. "Homeostasis and its regulation"						
Content module 1. Principles of nervous and humoral regulation of homeostasis parameters						
Topic 1. Study of the influence of changes in homeostasis parameters on the functioning of excitable tissues.	12	2	2	-	4	4
Topic 2. Study of the influence of various factors on homeostasis parameters. Nervous and humoral mechanisms of homeostasis regulation.	12	2	2	-	4	4
Together by content module 1	24	4	4	-	8	8
Content module 2. The role of visceral systems in ensuring homeostasis						
Topic 3. Research into the mechanisms of regulation of blood PO_2	8	1	2	-	-	5
Topic 4. Research into the mechanisms of blood $PSO_{2\ regulation}$	7.5	0.5	2	-	-	5
Topic 5. Research into the mechanisms of blood pH regulation	8.5	0.5	2	-	-	6

Topic 6. Research into the mechanisms of regulation of total blood osmotic pressure	8	1	2	-	-	5
Topic 7. Research into the mechanisms of regulation of blood oncotic pressure	7	-	2	-	-	5
Topic 8. Research into the mechanisms of regulation of circulating blood volume	8	1	2	-	-	5
Topic 9. Research into the mechanisms of regulation of the concentration of sodium and potassium ions in the blood	11	1	2	-	3	5
Topic 10. Research into the mechanisms of regulation of calcium ion concentration in the blood	8	1	2	-	-	5
Together by content module 2	6 6	6	16	-	3	41
Total hours	90	10	2 0	-	1 1	49
TOGETHER	90	10	2 0	-	1 1	49

Lecture topics

No.	Topic name	Number of hours
Module 1. Homeostasis and its regulation		
1.	The concept of homeostatic constants and their significance for vital activity. Principles of nervous and humoral regulation of homeostasis parameters.	2
2.	The role of visceral systems in ensuring homeostasis. Regulation of oxygen tension in the blood.	2
3.	Regulation of isoosmia and isovolemia .	2
	Total hours	***6***
	TOGETHER	***6***

5. According to the curriculum, seminar classes are not provided.

6. Topics of practical classes

No.	Topic name	Number of hours
Module 1. Homeostasis and its regulation		
1.	Study of the impact of changes in homeostasis parameters on the functioning of excitable tissues.	2
2.	Study of the influence of various factors on homeostasis parameters. Nervous and humoral mechanisms of homeostasis regulation.	2

3.	Research into the mechanisms of regulation of blood PO_2	2
4.	blood $_{PCO2}$ regulation	2
5.	blood pH regulation	2
6.	Research into the mechanisms of regulation of total blood osmotic pressure	2
7.	Research into the mechanisms of regulation of blood oncotic pressure	2
8.	Research into mechanisms of regulation of circulating blood volume	2
9.	Research into the mechanisms of regulation of the concentration of sodium and potassium ions in the blood	2
10.	Research into the mechanisms of regulation of calcium ion concentration in the blood	2
	Total hours	***2 0***
	TOGETHER	***2 0***

7. According to the curriculum, laboratory classes are not provided.

8. Independent work

No.	**Topic name**	**Number of hours**	**Type of control**
Module 1. Homeostasis and its regulation			
1.	**Preparation for practical classes –** *theoretical training and development of practical skills*	49	Current control in practical classes
Total hours		***49***	
TOGETHER		***49***	

9. Individual tasks

Individual independent work is performed by students if they wish to receive additional points and is assessed during the ongoing control process at the relevant (to the topic of the work) practical classes and during the final control (exam). The maximum number of points assigned to students as "credited" for individual work is 10 points. Points for individual work can be received by students who wrote and presented essays (reports using multimedia technology) on recommended topics using additional educational and scientific literature, or who took prizes in the discipline Olympiad among students of their university and higher educational institutions of Ukraine.

Tasks for independent work

No. salary	**Topic name**	**Number of hours**	**Type of control**

Module 1. Homeostasis and its regulation			
1.	Literature analysis and discussion on the topic: “The influence of the ionic composition of perilymph and endolymph on the functioning of the auditory and vestibular sensory systems ”	3	Current control
2.	Literature analysis and discussion on the topic: “Mechanisms of regulation of temperature homeostasis”	3	
3.	Literature analysis and discussion on the topic: “The role of innate and acquired behaviors in maintaining homeostasis ”	2	
4.	Literature analysis and discussion on the topic: “The role of various nuclei of the hypothalamus as an integrative center in ensuring innate and acquired homeostatic behavioral reactions”	3	
	Total hours	***11***	
	TOGETHER	***11***	

11. Teaching methods

I. Methods of organizing and implementing educational and cognitive activities in the study of the discipline:

- verbal: lectures using presentations. The lectures reveal problematic issues of the relevant sections of physiology regarding homeostatic constants and mechanisms of their regulation. Explanation of the contours of regulation of physiological functions.
- visual: observations, illustrations, demonstrations.
- practical classes include:

1) research by students of physiological functions in experiments on animals, isolated organs, cells, models or based on virtual research presented in computer programs and other educational technologies;

2) research into the functions of a practically healthy person;

3) solving situational problems (assessment of function indicators, homeostasis parameters, regulation mechanisms, etc.) that have practical significance in the future doctor's further professional activities.

II. Methods differ in the logic of transmitting and perceiving educational information: inductive, deductive, analytical, synthetic.

III. Methods of different levels of independent thinking: reproductive, search, research.

Independent work of students: with literature; implementation of individual educational projects .

12. Methods and forms of control, distribution of points received by students, assessment of discipline

Evaluation of current learning activities

The assimilation of lecture material and independent work of students is assessed during the ongoing control in the relevant practical classes and during the final control.

Indicative criteria for evaluating current educational activities

Practical classes in physiology are structured and involve a comprehensive assessment of all types of learning activities (learning tasks) that students perform during the practical class:

1) At the initial stage of practical training, a test control is carried out: the tests contain at least 10 test tasks of a selective type with one correct answer. Its results are evaluated positively if the student gave at least 60% of correct answers; the student does not receive points if the number of correct answers is less than 60%. In the overall assessment of the current educational activity, this stage is 20%.

2) At the main stage of the practical session, the following are assessed **:**

2.1) performing practical work (research), writing a research protocol in accordance with the requirements, the ability to analyze and interpret research results and correctly draw substantiated conclusions;

2.2) solving situational problems, drawing graphs, diagrams, and regulation contours.

In the overall assessment of the current educational activity, this stage is 50%. **,** if the student correctly completed the practical work (research), wrote down the research protocol in accordance with the requirements, was able to analyze and interpret the research results, draw substantiated conclusions, and also correctly solved all the proposed situational tasks and other tasks.

A student scores 40% of points if he/she correctly completed the practical work (research), wrote a research protocol in accordance with the requirements, was able to analyze and interpret the research results, draw substantiated conclusions, and solved at least half of the proposed problems.

A student scores 30% of points if he/she correctly completed the practical work (research), wrote a research protocol in accordance with the requirements, was able to analyze and interpret the research results, draw reasonable conclusions, and did not solve any of the proposed tasks.

A student does not earn points at the main stage of educational activity if he or she fails to correctly complete practical work (research), write a research protocol in accordance with the requirements, analyze and interpret the research results, and draw substantiated conclusions.

3) At the final stage of the practical session, the control of theoretical and practical training is carried out using test tasks (at least 10) or solving complex situational tasks, creating regulation contours and other tasks, which allows you to assess the degree of achievement of the educational goal. It is assessed positively provided that the student correctly solved at least 60% of the test tasks or solved all situational tasks and other tasks. Provided that the student correctly solved less than 60% of the test tasks or did not solve the proposed situational tasks, the student does not receive any points. In the overall assessment of the current educational activity, this stage is 30%.

Comprehensive assessment of educational activities is carried out by assigning a traditional grade (on a 4-point scale), which is converted into points on a 200-point scale (the grade is determined by the number of topics in the discipline - *see the points distribution tables*). The student receives during the practical session:

grade “5” – if he completed at least 90% of the learning tasks correctly;

grade “4” – if he completed at least 75% of the learning tasks correctly;

grade “3” – if he completed at least 60% of the learning tasks correctly;

grade “2” – if he completed less than 60% of the learning tasks correctly.

At the final stage of the lesson, the teacher gives a traditional grade on a 4-point (traditional) scale ("5", "4", "3", "2") according to the criteria for evaluating the student's current activity in the student's progress journal and notebook for practical classes, where all tasks must be completed and research protocols recorded, and puts his signature and date.

Assessment of current learning activities is carried out at each practical lesson on the relevant topic. The student is given grades on a 4-point (traditional) scale ("5", "4", "3", "2"). Grades given on a traditional scale are converted into points.

The maximum number of points that a student can score for current academic activity when studying the discipline **is 190** points (***additionally, from*** **1** to **10** points can be obtained for individual independent work).

possible **approaches** to conversion.

Approach 1. *Conversion into points before the final control :*

The calculation of the number of points is carried out on the basis of **the positive grades** received by the student on the traditional scale during the study of the discipline, by calculating the arithmetic average (**SA**), rounded to two decimal places, divided by the maximum traditional grade, namely " **5** ", and multiplied by the maximum score for the current educational activity, namely **190.** The resulting value is converted into points on a multi-point scale as follows:

$$x = CA \times 190 / 5$$

For convenience, here is a conversion table based on a 200-point scale:

Conversion of the average grade for current activities into a multi-point scale for the discipline, which ends with a final test (differential assessment)

4-point scale	200-point scale	4-point scale	200-point scale	4-point scale	200-point scale	4-point scale	200-point scale
5	190	4.21	160	3.42	130	2.63	100
4.92	187	4.13	157	3.37	128	2.58	98
4.87	185	4.08	155	3.29	125	2.5	95
4.79	182	4	152	3.21	122	2.42	92
4.71	179	3.92	149	3.13	119	2.36	90
4.63	176	3.87	147	3.08	117	2.29	87
4.55	173	3.79	144	3.03	114	2.21	84
4.5	171	3.71	141	3	111	2.13	81
4.42	168	3.63	138	2.87	109	2.08	79

4.34	165	3.55	135	2.79	106	2.03	77
4.29	163	3.5	133	2.71	103	2	0

Or the sum (**C**) **<u>of positive</u>** grades on the traditional scale is calculated, divided by the maximum traditional grade, namely " **5** " multiplied by the number of classes in the discipline, the resulting number is multiplied by the maximum score for the current educational activity, namely **19 0** . The resulting value is converted into points on the multi-point scale as follows:

x = C×190 / 5×N classes

Approach 2. *<u>Conversion into points for each lesson</u> :*

The number of points corresponding to the grade "5" is calculated by dividing the maximum number of points for the current educational activity, namely **190** , by the number of practical classes. To calculate the grade "3", the number of points is calculated, which is 60% of the maximum number of points for the current educational activity, i.e. 111 points, divided by the number of practical classes.

Form of final control of learning success (differential credit)

The final final control (differential assessment) is carried out after the completion of the study of the discipline based on the results of current training, the implementation of individual and control measures . When setting the grade for the discipline, the number of points accumulated by the student for current training is taken into account **(the maximum number of points is 200)** . The student is credited for the discipline differentially according to the total number of points accumulated by him, which must be no less than the minimum required, and corresponds to the minimum value of the grade E, and therefore is **111 points .**

*Before issuing a grade for a discipline, the student is given the right to retake unsatisfactory grades no later than **three days** before the final examination in order to accumulate the minimum number of points for passing the discipline.*

The department does not conduct differential credit in the form of a separate lesson.

Scheme of calculation and distribution of points received by students

“ Homeostasis and its regulation ”. *Number of study hours /* ECTS credits : 90/3.0. Number of content modules: No. 1-3	Number of practical training	Conversion to traditional grades					Minimum number of	Maximum number of points
		Traditional assessments				Points for completing individual tasks as a type of KTC		
		“5”	**“4”**	**“3”**	**“2”**			
For current educational activities	10	19	15.5	11.1	0	10	111	200
For mastering discipline							11 1	200

Discipline assessment.

The results of studying the discipline are assessed using the 200-point knowledge control system adopted at the university and the national scale, and are reflected in the relevant information.

The grade for the discipline “Homeostasis and its Regulation”, which is completed by a differential assessment, is determined as the sum of the points accumulated by the student for the current educational activity **(maximum number of points 200)** . At the same time, to be credited with a credit for the studied discipline, the total number of points received by the student must be no less than the minimum, which is determined by the curriculum for the discipline and corresponds to the minimum value of the grade E, and, therefore, is **111 points** .

Discipline scores for students who have successfully completed the program are independently converted to both the ECTS scale and the national (four-point) scale. ECTS scale scores are not converted to the 4-point scale and vice versa, since the ECTS scale and the four-point scale are independent .

Assessment of knowledge in the discipline is carried out according to the appropriate scale:

Score	National scale assessment	ECTS score	
		Rating	Explanation
170 – 200	perfectly	A	Excellent (excellent performance with only a few errors)
155 – 169	good	B	Very good (above average with a few errors)
140 – 154		C	Good (generally correct execution with a certain number of significant errors)
125 – 139	satisfactorily	D	Satisfactory (not bad, but with a significant number of shortcomings)
111 – 124		E	Sufficient (performance meets minimum criteria)
60 – 110	unsatisfactorily	FX	Unsatisfactory (with the possibility of reassembly)
0 – 59		F	Unsatisfactory (with mandatory re-study of the discipline)

If a student receives an unsatisfactory grade in a discipline within the range of 60-110 points (FX), he/she has the right to retake it twice: once to the departmental commission with the participation of the head of the department, and the last time to the commission with the participation of the head of the department and the dean.

If a student receives an unsatisfactory grade in a discipline within the range of 1-59 points (F), he/she is required to re-study it during extracurricular hours on a paid basis.

The objectivity of the assessment of students' academic performance is verified by statistical methods (correlation coefficient between ECTS and assessment on the national scale).

13.Methodological support

Methodical, didactic literature to ensure the academic discipline is indicated in the curricula for the discipline "Hemostasis and its Regulation" depending on the provision of literature to the departments (educational content (synopsis or extended lecture plan), plans for practical classes, tasks for independent work, questions, tasks or cases for current and final control of students' knowledge and skills, comprehensive control work after certification monitoring of acquired knowledge and skills in the academic discipline).

1. Basic and additional literature.
2. Test tasks of format A (study guide).
3. List of questions for preparing and compiling a PC (basic, intermediate, final level).
4. Block of questions for written answers on the PC (exams).
5. Multimedia support for lecture materials and practical classes.
6. Blocks of situational tasks.
7. Physiology. Edited by Igor Karvatsky . A textbook for practical classes and independent work of students. In 2 volumes. – Kyiv: Knyga-plus, 2022. T.1 – 320 p., T.2 – 424 p.
8. Methodological recommendations for lectures on the discipline "Homeostasis and its regulation" for students of the Medical Faculty, Department of Physiology, O.O. Bogomolets National Medical University, 2023.
9. Methodological recommendations for practical classes in the discipline "Homeostasis and its regulation" for students of medical faculties of the Department of Physiology of the O.O. Bogomolets National Medical University, 2023.
10. A set of scientific, educational and teaching-methodical videos.
11. A set of computer training programs.
12. TestShell 6 Office (Version 6.01) CS. I.M. Karvatsky , E.V. Gorshkov . - a universal software package designed for creating various tests, conducting testing and processing results.
13. TestShell Personal Edition 6.01; I.M. Karvatsky , E.V. Gorshkov . – a universal test system designed for individual preparation of students and interns for the PMK, exams, LII "Step", etc.

14.Recommended reading

Basic

1. McDonald R.B. *Biology of Aging*. 2nd ed. Boca Raton: CRC Press, 2019. 400 p.
2. Arking R. *Biology of Aging: Observations and Principles*. 5th ed. New York: Oxford University Press, 2019. 600 p.
3. Musi N., Hornsby P.J. (eds.) *Handbook of the Biology of Aging*. 9th ed. Amsterdam: Elsevier, 2024. 650 p.

4. Carlberg C., Ulven S.M., Velleuer E. *Aging: How Science Works*. Cham: Springer, 2024. 300 p.
5. Yashin A.I., Jazwinski S.M. *Aging and Health: A Systems Biology Perspective*. Basel: Karger, 2014. 250 p.

Auxiliary

1. Bilder G.E. *Human Biological Aging: From Macromolecules to Organ Systems*. New York: Routledge, 2016. 352 p.
2. Taylor A.W., Johnson M.J. *Physiology of Exercise and Healthy Aging*. 2nd ed. New York: Human Kinetics, 2021. 480 p.
3. Schlaerth K.R. *The Ways Our Bodies Age: The Physiology of Aging*. New York: Rowman & Littlefield, 2025. 280 p.
4. Arking R. *Biology of Longevity and Aging: Observations and Principles*. 2nd ed. New York: Oxford University Press, 2019. 520 p.
5. Kenney R.A. *Physiology of Aging: A Synopsis*. New York: Springer, 1989. 200 p.

Information resources

1. American Physiological Society (APS). URL: https://www.physiology.org
2. The Physiological Society (UK). URL: https://www.physoc.org
3. Gerontological Society of America (GSA). URL: https://www.geron.org
4. National Institute on Aging (NIA, NIH). URL: https://www.nia.nih.gov
5. Aging Cell (Wiley). URL: https://onlinelibrary.wiley.com/journal/14749726 (onlinelibrary.wiley.com in Bing)
6. The Journals of Gerontology: Series A (Oxford Academic). URL: https://academic.oup.com/biomedgerontology (academic.oup.com in Bing)
7. Mechanisms of Ageing and Development (Elsevier). URL: https://www.sciencedirect.com/journal/mechanisms-of-ageing-and-development (sciencedirect.com in Bing)
8. PubMed (NIH). URL: https://pubmed.ncbi.nlm.nih.gov (pubmed.ncbi.nlm.nih.gov in Bing)
9. OpenStax – Anatomy & Physiology. URL: https://openstax.org/details/books/anatomy-and-physiology (openstax.org in Bing)
10. Khan Academy – Health and Medicine. URL: https://www.khanacademy.org/science/health-and-medicine (khanacademy.org in Bing)
11. TeachMePhysiology. URL: https://teachmephysiology.com
12. Armando Hasudungan (YouTube). URL: https://www.youtube.com/user/armandohasudungan (youtube.com in Bing)
13. Osmosis (YouTube). URL: https://www.youtube.com/c/osmosis