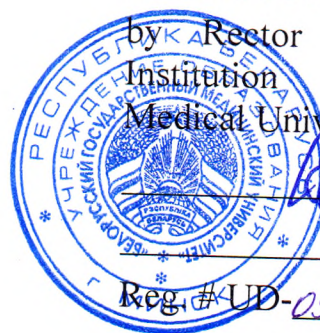


**MINISTRY OF HEALTH OF THE REPUBLIC OF BELARUS**  
Educational Institution  
«BELARUSIAN STATE MEDICAL UNIVERSITY»

**Контрольный  
экземпляр**

**APPROVED**



by Rector of the Educational  
Institution «Belarusian State  
Medical University»

*[Signature]* S.P. Rubnikovich

*01.12.2025*

Reg. # UD-*0912-01-19/2528* edu.

**PATHOLOGICAL PHYSIOLOGY**

**Curriculum of the educational institution  
in the academic discipline for the specialty**

**7-07-0912-01 «Pharmacy»**

Curriculum is based on the educational program «Pathological Physiology», approved 15.11.2023, registration # № УД-091-010/2324/уч.; on the educational plan in the specialty 1-79 01 08 «Pharmacy», approved 15.05.2024, registration # № 7-07-0912-01/2425/mf.

**COMPILERS:**

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S.A.Zhadan, Associate Professor of the Pathological Physiology Department of the Educational Institution «Belarusian State Medical University», PhD, Associate Professor

**RECOMMENDED FOR APPROVAL:**

by the Pathological Physiology Department of the Educational Institution «Belarusian State Medical University»  
(protocol # 12 of 20.05.2025);

by the Scientific and Methodological Council of the Educational Institution «Belarusian State Medical University»  
(protocol # 10 of 26.06.2025)

## EXPLANATORY NOTE

«Pathological Physiology» is an academic discipline of the «Human Physiology» Module, containing systematized scientific knowledge about the patterns of occurrence and development of the human body disorders; causes, mechanisms of development, outcomes of typical forms of pathology and their significance for the human body.

**The objective** of the academic discipline «Pathological Physiology» is the formation of basic professional competence for understanding the principles of pharmacological prevention and correction of the most common forms of pathological processes and human diseases.

**The tasks** of the academic discipline «Pathological Physiology» are to develop students' scientific knowledge about:

the basic concepts of general nosology;

the role of causes, conditions and reactivity of the human body in the occurrence, development and outcome of a disease;

the causes, mechanisms and main manifestations of typical pathological processes, as well as their significance for the human body in the development of various diseases;

the causes, mechanisms and main manifestations of typical dysfunctions of individual organs and physiological systems of the body;

general patterns of occurrence, development and outcomes of the most common human diseases, as well as the main manifestations of these diseases to justify measures for the prevention and pharmacological therapy of the most important forms of pathological processes;

the skills and abilities necessary to interpret the nature of changes in the human body in typical forms of pathological processes and to provide pharmaceutical counseling to a pharmacy visitor.

### **Connections with other academic disciplines**

The knowledge, skills and abilities gained in the study of the discipline «Pathological Physiology» are necessary for the successful study of the educational discipline modules «Pharmacology and Pharmacotherapy», «First Aid», «Pharmaceutical Care».

A student who has mastered the content of the academic material of the academic discipline should have the following basic professional competence:

identify symptoms that require immediate medical attention or allow the use of over-the-counter medications.

As a result of studying the discipline «Pathological Physiology» the student should

#### **know:**

basic concepts of general nosology;

causes, main mechanisms of development and outcomes of typical pathological processes;

the main patterns and mechanisms of the development of the disease and recovery;

compensation mechanisms and principles of correction of structural and functional disorders in typical forms of pathology of organs and systems of the human body;

pathogenic mechanisms of pharmacotherapy complications.

**be able to:**

identify symptoms that require immediate medical attention or that allow the use of over-the-counter medications;

identify deviations from the norm in body temperature, hemogram results, blood biochemistry, urine analysis and understand the causes of these abnormalities;

determine the main risk factors for a specific pathological process to determine preventive measures;

**master:**

skills in substantiating the main approaches to pharmacological prevention of human diseases, as well as to their etiotropic, pathogenic and symptomatic treatment.

**Total number** of hours for the study of the discipline is 220 academic hours, of which 126 classroom hours and 94 hours of student independent work. Classroom hours according to the types of studies: lectures – 24 hours (including 6 hours of supervised student independent work (SSIW)), laboratory classes – 102 hours.

Form of higher education is full-time.

Intermediate assessment is carried out according to the syllabus of the specialty in the form of a credit (6th semester) and examination (7th semester).

### ALLOCATION OF ACADEMIC TIME ACCORDING TO SEMESTERS OF STUDY

Code, name of the specialty	semester	Total number of academic hours	Number of academic hours					Form of intermediate assessment
			Total	lectures		laboratory classes	out-of-class self-studies	
				In-class	supervised student independent work			
7-07-0912-01 «Pharmacy»	6	110	63	9	3	51	47	credit
	7	110	63	9	3	51	47	examination
		<b>220</b>	<b>126</b>	<b>18</b>	<b>6</b>	<b>102</b>	<b>94</b>	

## THEMATIC PLAN

Section (topic) name	Number of class hours	
	lectures	laboratory
<b>1. General nosology</b>	<b>6</b>	<b>18</b>
1.1. Introduction. General doctrine of disease. General etiology and pathogenesis	3	6
1.2. Pathogenic influence of environmental factors on the human body	–	6
1.3. The role of the reactivity, constitution and age in pathology. The role of heredity in pathology	3	6
<b>2. Typical pathological processes</b>	<b>6</b>	<b>33</b>
2.1. Disorders of peripheral circulation and microcirculation. Thrombosis. Embolism	–	6
2.2. Pathophysiology of cell	1,5	3
2.3. Inflammation	1,5	6
2.4. Infection process. Fever	1,5	3
2.5. Hypoxia	–	3
2.6. Typical metabolic disorders	–	6
2.7. Tumor growth	1,5	6
<b>3. Pathophysiology of organs and systems</b>	<b>12</b>	<b>51</b>
3.1. Pathophysiology of the blood system	1,5	21
3.2. Pathophysiology of the cardio-vascular system	1,5	12
3.3. Pathophysiology of external respiration	3	3
3.4. Pathophysiology of the digestive system. Pathophysiology of the liver	1,5	3
3.5. Pathophysiology of the kidneys	1,5	3
3.6. Pathophysiology of the endocrine system	1,5	3
3.7. Pathophysiology of the nervous system	1,5	6
<b>Total hours</b>	<b>24</b>	<b>102</b>

### CONTENT OF THE EDUCATIONAL DISCIPLINE

#### 1. General nosology

##### 1.1. Introduction. General doctrine of disease. General etiology and pathogenesis

Pathological physiology as fundamental science and educational discipline. Subject and tasks of pathological physiology: its place in the system of medical education, as the theoretical basis of modern clinical medicine. The importance of general and specific patterns of pathological physiology for the development and

implementation of the preventive direction of the modern health care system, the improvement and creation of new methods and means of treating diseases.

Brief information from the history of pathological physiology, the main stages of its development. The role of domestic scientists in the development of pathological physiology.

Methods of pathological physiology. The value of an experiment in the development of experimental and clinical medicine pathophysiology. General principles of biomedical experiments and their results interpreting. Modern methods used in pathophysiological experiment. Modeling: its types, capabilities and limitations. Animal model of various forms of pathological processes and protective-adaptive reactions in man; value of comparative evolutionary method. Moral and ethical aspects of experiments on animal. Role of the newest advances in molecular biology, genetics, biophysics, biochemistry, electronics, mathematics, cybernetics, ecology and other sciences in the development of modern pathophysiology. Experimental therapy as an important method for the study of diseases and the development of new treatment methods.

Basic concepts of general nosology: norm, health, pathological process, pathological condition, pathological reaction. Concept of symptom and syndrome. Disease as a dialectical unity of damage and protective-adaptive (sanogenic) reactions of organism. Stage of the disease, its outcomes. Complete or incomplete recovery. Remission, relapse, complications, transition to chronic form. Value of biological and social factors in human pathology. Principles of disease classification. General principles of disease prevention and treatment; the importance of pharmacological therapy and pharmacological prevention.

The concept of etiology. The role of causes and conditions in the occurrence of diseases; their dialectical relationship. The relationship between biological and social factors in the etiology of human diseases. The concept of external and internal causes of diseases. The main categories of pathogenic factors. Side effects of drugs as possible pathogenic factors. The principle of etiotropic prevention and treatment of diseases.

The concept of pathogenesis. Damage as the initial link of pathogenesis. Levels of damage: submolecular, molecular, subcellular, cellular, organ-tissue, systemic, organismic. Unity of functional and structural changes in the pathogenesis of diseases.

Cause-and-effect relationships in pathogenesis: primary, secondary damage. Leading links in pathogenesis, the concept of (vicious circles). Protective and adaptive capabilities of a healthy and sick organism (defensive reactions, compensatory and restorative processes), their dialectical relationship with damage processes and significance in the recovery of a sick organism. The concept of sanogenesis: the main sanogenic mechanisms.

The principle of pathogenic therapy of diseases. Possibilities and main directions of pathogenic pharmacological therapy.

## **1.2. Pathogenic influence of environmental factors on the human body**

Pathogenic effects of low and high ambient temperatures on the body: hypothermia and hyperthermia.

Effects of altered barometric pressure (low and high) on the body. Mountain and high-altitude sickness. Caisson disease.

Pathogenic effects of chemical factors; exogenous and endogenous intoxications.

Electric current and its damaging effects on the body.

Effects of ionizing radiation on the body. Radiation sickness.

General principles of prevention and treatment of radiation injuries and radiation sickness. The main routes of pharmacotherapy for acute radiation sickness: anti-infective and detoxification therapy; elimination of body hypohydration; stabilization of biological membranes; stimulation of regenerative processes; symptomatic therapy.

Pathogenic effects of chemical factors, alcohol and narcotics on the body. Medicines as pathogenic factors.

The importance of drug abuse.

Characteristics of the pathogenic action of physical factors: mechanical damage, hypo- and hyperdynamics, hypothermia and overheating. Meteorological factors, consequences of their impact.

Biological factors. Viruses, rickettsia, bacteria and parasites as causes of infectious diseases.

Psychogenic pathogenic factors, the concept of iatrogenic diseases.

The importance of social factors in maintaining health and the occurrence of human diseases. Ecological aspects of general pathology.

Extreme living conditions and extreme states: general characteristics, differences.

Etiotropic principle of disease prevention and treatment.

Critical analysis of some concepts of general nosology (monocausalism, conditionalism, constitutionalism).

### **1.3. The role of the reactivity, constitution and age in pathology. The role of heredity in pathology**

Reactivity of the organism, its types, indicators and evolutionary aspects. Reactivity and resistance. Factors determining reactivity (age, gender, individual characteristics of the organism). The relationship between reactivity and resistance. The role of reactivity in the development of the infectious process. Specific and non-specific protective factors.

The influence of environmental factors on the reactivity of the organism: the role of social and ecological factors. Pathological reactivity, its types and forms of manifestation. Directed change of individual and group reactivity as the most important means of disease prevention and treatment. Factors ensuring a decrease in non-specific resistance, ways and means of increasing it.

Immunogenic reactivity, its forms, immunodeficiency states. Causes of occurrence, mechanisms of formation and manifestation of immunodeficiency states. The role of chemical factors and drugs in the development of secondary immunodeficiency.

Allergy as a form of pathological reactivity. Exogenous and endogenous allergens, classification. Types of allergy; drug allergy. Types of allergic reactions,

causes and mechanisms of development. Manifestations of immediate and delayed allergies. Anaphylactic shock. Hay fever, bronchial asthma, urticaria and Quincke's edema. Serum sickness. The concept of pseudoallergy.

The concept of autoimmune diseases, their significance in human pathology, classification. Mechanisms of immune tolerance impairment and the occurrence of immune autoaggression.

The doctrine of the constitution. Classification of constitutional types, significance in pathology.

Causes and mechanisms of aging. Theories of aging. Features of manifestation and course of the disease in old and senile age. Ways to prolong human life.

The concept of hereditary and congenital diseases, phenocopies, monogenic and polygenic hereditary diseases.

Causes of hereditary pathology. Mutations and their types. Mutagenic factors. The importance of ionizing radiation and chemical pollution of the environment. Medicines as possible mutagens. The concept of epigenetic regulation of gene activity.

Mechanisms of formation of hereditary pathology. Types of transmission of genetic hereditary diseases: autosomal dominant, autosomal recessive, codominant, mixed and sex-linked. Penetrance and expressivity of hereditary diseases. Hereditary diseases of metabolism. Chromosomal diseases. Hereditary predisposition to diseases. The importance of heredity in the development of multifactorial diseases.

Methods of hereditary pathology studying. General principles and social aspects of prevention and treatment of hereditary diseases. Tasks of medical and genetic consultation. Prenatal diagnostics and prenatal therapy of hereditary diseases.

Pathology of intrauterine development. The concept of gametopathies, blastopathies, embryopathies and fetopathies. The importance (critical periods) in the development of the embryo and fetus. Medicines as a cause of pathology of intrauterine development. The relationship of fetal pathology with harmful effects on the mother's body.

## **2. Typical pathological processes**

### **2.1. Disorders of peripheral circulation and microcirculation. Thrombosis. Embolism**

Main forms of regional circulatory disorders (arterial hyperemia, venous hyperemia, ischemia, stasis), their types, causes, mechanisms of development, external manifestations, changes in microcirculation and remote consequences. Reperfusion injury, principles of drug therapy for regional circulatory disorders.

Disorders of blood, lymph and tissue fluid microcirculation. Changes in blood rheological properties; phenomena of «sludge» and microthrombosis. Disorders of vascular wall permeability, filtration and resorption processes. Causes and mechanisms of microcirculation disorders, the concept of capillary-trophic insufficiency. Consequences of microcirculation and lymphodynamics disorders. Principles of pharmacological therapy for microcirculatory disorders: normalization of blood rheological properties and prevention of sludge; reduction of vascular wall adhesive properties; inhibition of platelet aggregation; reduction of blood clotting; activation of

thrombolysis mechanisms; decreased permeability of vascular tissue membranes, improved lymph flow.

Thrombosis and embolism as common causes of local blood flow disorders. Causes and conditions of thrombosis. Stages and mechanisms of the thrombus formation process; types of thrombi. Causes and mechanisms of emboli formation; types of emboli. The meaning, outcomes and consequences of thrombosis and embolism, principles of prevention and treatment.

## **2.2. Pathophysiology of cell**

Causes of cell damage: the action of physical, chemical and biological factors. Exogenous and endogenous pathogens causing cell damage.

General mechanisms and main manifestations of cell damage. Direct and indirect action of the damaging agent on the cell. Mechanisms of disruption of energy production processes in the cell. Main mechanisms and consequences of damage to cell membranes. Consequences of damage to cellular structures: nucleus, mitochondria, endoplasmic reticulum, peroxisomes, Golgi complex. Mechanisms of cell protection and adaptation to damaging effects. Microsomal detoxification system, buffer systems, antioxidant and antimutation systems, heat shock proteins, proteasome. Adaptive changes in the functional activity of the cell and its genetic apparatus. Reversible and irreversible cell damage. Disorders of the structures and functions of damaged cells and intercellular interaction processes.

Forms of cell death (apoptosis, necrosis) and their characteristics.

General principles of preventing and eliminating cell damage. Pharmacological therapy methods: increasing the adaptive properties of cells; decreasing their metabolic and functional activity; normalizing microcirculation, membrane-stabilizing effects; stimulating reparative processes in damaged cellular structures.

General reactions of the body to injury: acute phase response, shock, collapse, coma. Definition of shock, its types. Pathogenesis of shock conditions; characteristics of its main components: disorders of regulation, macro- and microcirculation, metabolism; mechanism and pathogenic assessment of blood flow shunting; centralization of blood circulation. Similarities and differences between individual types of shock. Stages of shock, functional and structural disorders at different stages of shock. The importance of the functional state and reactive properties of the body for the outcome of shock. Irreversible changes at shock. Pathophysiological foundations of shock prevention and treatment.

Collapse: definition and characteristics of collapse, its types, causes and mechanisms of development, main links in pathogenesis. Principles of collapse therapy. Fainting: etiology and pathogenesis.

Coma, definition, characteristics, types. Etiology and pathogenesis of comatose states, disorders of human body functions, principles of treatment.

## **2.3. Inflammation**

Inflammation: general characteristics, etiology, classification. Local and general manifestations of inflammation. Inflammation as a staged process. The main components of inflammation: alteration, vascular reactions with exudation, leukocyte emigration and phagocytosis, proliferation.

Acute inflammation. Alteration: types, significance. Changes in local blood circulation and microcirculation in the inflammation focus, stages and mechanisms. Exudation: mechanisms, significance. Types of exudates. Leukocyte emigration, its mechanisms. Phagocytosis and its significance. Mechanisms of phagocytosis. Disturbances in phagocyte activity. Proliferation, its mechanisms and significance.

Endogenous mechanisms that control the course of inflammation.

Chronic inflammation: causes, mechanisms of development. The key role of macrophages in the development of chronic inflammation.

Inflammatory mediators: types, origin, participation in the development of inflammation.

Systemic reactions in inflammation. Characteristics of acute phase proteins of inflammation.

The relationship between damage and protective-adaptive reactions in the inflammatory process. Biological significance of inflammation. The concept of the wound process. Wound healing mechanisms.

General principles of inflammation prevention and treatment. Basic principles of pharmacological therapy of inflammation: etiologic and pathogenic.

#### **2.4. Infectious process. Fever**

Infectious process as a form of interaction between micro- and macroorganism. General mechanisms of anti-infective resistance of the body. Ways of introduction of infectious agents into the body and their spread. Stages of the infectious process, outcomes and complications. Sepsis, etiology and pathogenesis.

Ways of infectious diseases preventing. Principles of pharmacological intervention in the infectious process: impact on pathogens, correction of the immune response; stimulation of non-specific resistance mechanisms.

The concept of fever and its general characteristics. Etiology of febrile reactions. Infectious and non-infectious fever. Exogenous and endogenous pyrogenic substances, their chemical nature and sources of formation during the infectious process, aseptic tissue damage during immune reactions. Changes in thermoregulation at different stages of fever, their mechanisms. The concept of types of febrile reactions. Changes in metabolism and physiological functions during fever. Biological significance of fever. Distinction of fever from exogenous or endogenous hyperthermia; concept of heatstroke and sunstroke.

Principles of antipyretic therapy. Concept of pyrotherapy. Methods of pharmacological induction of artificial fever.

#### **2.5. Hypoxia**

Definition of the concept, general characteristics of hypoxia as a state of absolute or relative insufficiency of biological oxidation. Types of hypoxia. Etiology and pathogenesis of the main types of hypoxia: exogenous, respiratory, circulatory, hemic, tissue, mixed. Disorders of metabolism and physiological functions in acute and chronic hypoxia. Emergency and long-term adaptation to hypoxia.

General principles of prevention and treatment of hypoxic conditions. Use of hyperbaric oxygenation in the prevention and treatment of severe forms of hypoxia. Ways of pharmacological therapy of hypoxic conditions: increasing the body's resistance to hypoxia by reducing the overall level of functional activity of the body

and energy expenditure; prospects for specific intervention in the process of biological oxidation using antihypoxants of various mechanisms of action.

Emergency and long-term reactions of adaptation and compensation in hypoxia, their mechanisms.

Disorders of metabolism, structure and function of cells and physiological functions of the body in acute and chronic hypoxia. Reversibility of hypoxic conditions. Effect of hyper- and hypocapnia on the development of hypoxia. Pathophysiological bases of prevention and treatment of hypoxic conditions. Experimental models of different types of hypoxia. Adaptation and compensation mechanisms. Protective effects of adaptation to hypoxia.

Hyperoxia: definition of the concept and its role in pathology. The role of free radicals in the development of hypoxia. Therapeutic effect of hyperoxia: hyperbaric oxygenation and its use in medicine.

## **2.6. Typical metabolic disorders**

Acid-base balance disorders. Classification of the main types of acid-base balance disorders in the internal environment of the body. Gaseous (respiratory) acidosis and alkalosis. Non-gaseous forms of acidosis and alkalosis: metabolic, excretory (renal and gastrointestinal), exogenous. Compensatory reactions in acute and chronic acid-base balance disorders. Changes in acid-base balance indicators in the body with various types of acidosis and alkalosis, principles of correction.

Water metabolism disorders. Hyper-, iso- and hyposmolar dehydration. Edema. Pathogenic factors of edema, the importance of gradients of hydrodynamic, osmotic and oncotic pressure in the blood and tissues, the state of vascular-tissue membranes. The role of neurohormonal mechanisms in the development of edema. Types of edema. Pathogenesis of cardiac, renal, inflammatory, allergic, hunger edema. Local and general disorders in edema, principles of their treatment, experimental models.

Electrolyte metabolism disorders. Violation of the content and ratio of sodium, potassium, calcium, magnesium and trace elements ions in the body's fluids, between cellular and extracellular sectors. Main causes and mechanisms of electrolyte imbalance disorders. The relationship between water, ion and acid-base balance. Disorders of metabolism and physiological functions in the most common forms of electrolyte imbalance.

Carbohydrate metabolism disorders. Disorders of the breakdown and absorption of carbohydrate food, the processes of synthesis, deposition and breakdown of glycogen, carbohydrate transport into cells and carbohydrate absorption. Hypoglycemia: types and mechanisms of occurrence. Hyperglycemia: types and mechanisms of occurrence. Diabetes mellitus, its types. Etiology and pathogenesis of different types of diabetes mellitus. Mechanisms of insulin resistance. Disorders of carbohydrate and other types of metabolism in diabetes mellitus, disorders of physiological functions, complications, their mechanisms. Diabetic coma. Disorders of carbohydrate metabolism in hereditary enzymopathies. Glycogenoses.

Disorders of protein metabolism. Positive and negative nitrogen balance. Causes of protein deficiency and its consequences. Disorders of intermediate amino

acid metabolism. Dysproteinemia. Types, consequences. Disorders of the final stages of protein metabolism, urea synthesis. Hyperazotemia, its types and consequences for the body. Hereditary disorders of protein metabolism. Disorders of the protein composition of blood plasma: hyper-, hypo-, dysproteinemia.

Pathology of nucleoprotein metabolism. Disorders of purine and pyrimidine bases. Gout. The role of exo- and endogenous factors in the development of gout. Prevention methods.

Disorders of lipid metabolism. Primary and secondary dyslipidemia. dyslipoproteinemia, classification.

General obesity, types and mechanisms. Pathology of intermediate lipid metabolism. Disorders of phospholipid metabolism. Hyperketonemia. Disorders of cholesterol metabolism; hypercholesterolemia. Atherosclerosis, pathogenesis and adverse effects.

Fasting. Exogenous and endogenous causes of fasting. Absolute, complete, incomplete, partial fasting, protein starvation. Protein-calorie (protein-energy) deficiency, its types: alimentary marasmus, kwashiorkor, alimentary dystrophy. Periods of complete fasting, changes in metabolism and physiological functions during different periods of complete fasting. Characteristics of incomplete and partial types of food fasting. The concept of therapeutic fasting.

Water and fat-soluble vitamins metabolism pathology. Manifestations of hypovitaminosis, avitaminosis and hypervitaminosis. Etiopathogenesis.

Typical metabolic disorders as risk factors for major non-communicable diseases (cardiovascular, oncological, diabetes).

## **2.7. Tumor growth**

Tumor growth. Etiology of tumors (physical, chemical and biological carcinogens). Comparative characteristics of malignant and benign tumors; principles of their classification. General properties of tumor cells.

The role and place of proto-oncogenes; suppressor genes; genes that control apoptosis and genes that control repair of DNA, as well as their products in the development of neoplasia. The role of epigenetic mechanisms in carcinogenesis. The importance of disruptions in the checkpoints of the mitotic cell cycle in the pathogenesis of tumors. Telomeres and telomeres in tumor cells. Biological features of neoplasia. Stages of the tumor process: transformation, progression, invasion and metastasis. Mechanisms of metastasis of a malignant tumor. Antitumor resistance of the body: immune and non-immune factors of antitumor resistance.

Interaction of tumor and organism. Local and systemic influence of tumor on organism. Paraneoplastic syndrome.

Pathophysiological bases of prevention, diagnostics and treatment of malignant neoplasms. General principles of surgical treatment, chemo-, radio- and immunotherapy of malignant tumors.

## **3. Pathophysiology of organs and systems**

### **3.1. Pathophysiology of the blood system**

Periods and types of hematopoiesis and their disorders.

Pathology of the erythron. Pathological forms of erythrocytes and hemoglobin. Anemias and erythrocytosis: definition of concepts, principles of classification (by

etiology and pathogenesis, type of hematopoiesis, color index, regenerative capacity of the bone marrow, size and shape of erythrocytes). Iron deficiency anemia. Anemia due to lack of vitamin B12 and folic acid (megaloblastic anemia), deficiency of erythropoietin and other factors of erythropoiesis. Achrestic anemia.

Anemia due to suppression of erythropoiesis by toxic effects, ionizing radiation and autoimmune processes. Hypo- and aplastic anemia. Anemia in leukemia and other tumor lesions of the bone marrow.

Anemia due to increased hemolysis. Hereditary hemolytic anemias (membranopathies, enzymopathies, hemoglobinopathies). Acquired hemolytic anemia. The role of autoimmune processes in the pathogenesis of anemia. Etiopathogenesis of hemolytic disease of the newborn.

Acute and chronic posthemorrhagic anemia.

Erythrocytosis: primary (erythremia) and secondary (absolute and relative erythrocytosis).

Disorders and compensatory-adaptive processes in the body in anemia and polycythemia.

Pathology of leukone. Disorders of the structure and function of individual types of leukocytes, their role in pathological processes. Leukocytosis, leukopenia, agranulocytosis: types, causes and mechanisms of development. Changes in the leukocyte formula. Panmyelophthisis.

The concept of hemoblastosis. Leukemia. Definition, general characteristics, principles of classification. Tumor nature of leukemia, the role of abnormal expression of oncogenes. Etiology of leukemia, the role of viruses, chemical carcinogens, ionizing radiation. Features of leukemic cells, their morphological, cytochemical, cytogenetic and immunological characteristics. Features of hematopoiesis and cellular composition of peripheral blood in different types of leukemia. The main disorders in the body in leukemia, their mechanisms. Principles of diagnosis and treatment of leukemia.

Leukemoid reactions. Types of leukemoid reactions, etiology, pathogenesis, changes in hematopoiesis and morphological composition of peripheral blood, differences from leukemia, significance for the body.

Disorders of the hemostasis system. Thrombocytosis, thrombocytopenia, thrombocytopathy. Hemorrhagic and thrombotic syndromes. Hereditary and acquired forms of vascular-platelet and coagulation hemostasis disorders. Thrombohemorrhagic hemostasiopathies. Disseminated intravascular coagulation syndrome (DIC syndrome), stages of development, clinical manifestations, consequences.

Changes in total blood volume: hypo- and hypervolemia, types, causes and mechanisms, significance for the body. Acute blood loss as the most common cause of hypovolemia. Emergency and long-term protective and adaptive reactions of the body during blood loss: restoration of blood volume, amount of plasma proteins and formed elements. Disorders of physiological functions during blood loss and in posthemorrhagic conditions; reversible and irreversible changes. Principles of blood loss treatment.

General principles of pharmacological therapy of hemorrhagic syndromes and thrombophilic syndromes.

### **3.2. Pathophysiology of the cardio-vascular system**

General etiology and pathogenesis of disorders of the circulatory system. Risk factors in the occurrence of cardiovascular pathology: controlled and uncontrolled. The importance of psychoemotional factors. The concept of circulatory failure, forms, main hemodynamic indicators and manifestations.

Heart failure, types. Overload form of heart failure. Overload by volume and pressure of blood in the heart cavity, etiology and pathogenesis. The concept of systolic and diastolic failure. Myocardial form of heart failure, causes and mechanisms.

Urgent and long-term heart failure. Intracardiac compensation mechanisms. Myocardial hypertrophy, features of the hypertrophied heart, decompensation mechanisms.

General and hemodynamic manifestations of heart failure. Principles of heart failure prevention.

Myocardial form of heart failure, causes and mechanisms. Absolute and relative coronary insufficiency. Pathogenesis of ischemic syndrome in coronary insufficiency. Clinical forms of coronary insufficiency. Ischemic heart disease, forms, causes and mechanisms of development. Angina pectoris. Myocardial infarction, metabolic disorders, electrogenic and contractile properties of the myocardium in the ischemic zone and outside it. Complications and outcomes of angina pectoris, myocardial infarction. Restoration of blood flow in the ischemic zone. Pathogenesis and clinical manifestations of myocardial reperfusion injury. Non-coronary forms of heart damage.

Myocardial damage in systemic diseases (diabetes mellitus, vitamin deficiencies, obesity, endocrine disorders, collagenosis). Principles of prevention and therapy of heart failure.

Heart rhythm disorders: types (arrhythmias due to impaired automatism, excitability and conductivity), causes, mechanisms of development, their manifestations on the ECG. Disorders of general and coronary circulation in cardiac arrhythmia. Principles of arrhythmia therapy.

Typical disorders of vascular tone. Arterial hypertension. Primary (essential) arterial hypertension: etiology, theories of pathogenesis, factors of increased arterial pressure. Secondary (symptomatic) arterial hypertension, types, causes and mechanisms of development. Hemodynamics in various types of arterial hypertension. Complications and consequences of arterial hypertension. Damage to the target organs in arterial hypertension. Relationship between arterial hypertension and atherosclerosis.

Arterial hypotension. Types, causes and mechanisms of development. Hypotonic disease. Collapse. Disorders of macro- and microcirculation in e, fainting, collapse. Pathogenic evaluation of shunting centralization of blood circulation in shock.

Pathophysiology of cerebral circulation. General etiology and pathogenesis. Main forms of disorders. Pathological reactions of cerebral vessels. Main forms of cerebrovascular disorders (paroxysms, crises, strokes), their general characteristics.

The role of atherosclerosis in the pathology of the cardiovascular system.

### **3.3. Pathophysiology of external respiration**

Etiology and pathogenesis of respiratory disorders. Concept of respiratory failure, stages and manifestations. Dyspnea, types, mechanisms of development.

Alveolar hypoventilation. Obstructive and restrictive types of ventilation disorders: causes and mechanisms of development. Disorder of alveolar ventilation caused by disturbance of its regulation mechanisms. Obstruction of the upper respiratory tract. Acute mechanical asphyxia: causes and mechanisms of development. Obstruction of the lower respiratory tract: pathogenesis of bronchitis respiratory regulation disorder and emphysematous types of obstruction. Reflex respiratory disorders, respiratory center lesions. Pathological forms of respiration, respiratory arrhythmia, periodic breathing, terminal breathing, apnea.

Pulmonary blood flow disorders, causes and consequences. General insufficiency of pulmonary perfusion. Pulmonary hypertension, pre- and postcapillary forms. Local unevenness of ventilation-perfusion relationships.

Disorders of alveolar capillary diffusion, causes and consequences. Mixed forms of external respiration disorders. Etiology and pathogenesis of acute respiratory failure in respiratory distress syndrome of adults and newborns.

Compensatory and adaptive processes in the external respiration system in case of damage to its individual links. Alveolar hyperventilation: causes, mechanisms of development, consequences. Changes in ventilation parameters, blood gas composition and acid-base balance in respiratory failure and hyperventilation.

The importance of maintaining clean air and combating smoking in the prevention of diseases of the external respiration system.

Principles of prevention and therapy of pathology of the external respiration system.

### **3.4. Pathophysiology of the digestive system. Pathophysiology of the liver**

General etiology and pathogenesis of digestive system disorders. The role of food composition and diet. The importance of neurogenic and humoral factors. Pathogenic effects of smoking, alcohol. Functional connections of various parts of the digestive system in pathological conditions. Digestive disorders in metabolic disorders.

Appetite disorders: hyporexia, anorexia, pararexia, hyperrexia.

Taste disorders. Disorders of salivation, hypo- and hypersalivation. Etiopathogenesis. Consequences. Disorders of chewing, swallowing, esophagus function.

Disorders of reservoir, secretory and motor functions of the stomach. Types of pathological secretion. Causes and consequences of hyposecretion and hypersecretion. Hypo- and hyperkinetic states of the stomach. Disorders of evacuation of gastric contents: belching, heartburn, nausea, vomiting. The relationship between secretory and motor disorders. Disorders of the small and large intestines, disorders of the secretory function. The importance of enterocyte damage, pancreatic achylia, acholia; the role of gastrointestinal hormones. Disorders of cavity

and parietal digestion, absorption disorders, intestinal motility disorders. Diarrhea, constipation, intestinal obstruction. Disorders of the intestinal barrier function, intestinal autointoxication, Coli sepsis, dysbiosis. Enteritis, colitis. Ulcer of the stomach and duodenum. Etiopathogenesis. Characteristics of aggression and defense factors and their disruption in the development of ulcers of the stomach and duodenum. The role of stress.

Disorders of the secretory function of the pancreas; acute and chronic pancreatitis. Their role in the occurrence of digestive disorders.

Principles of prevention and therapy of the main disorders of the digestive system.

General etiology and pathogenesis of liver diseases. Disorders of the portal circulation, arterial blood supply to the liver. Parenchymatous liver damage: inflammatory (acute and chronic hepatitis), dystrophic, cholangiostatic. Liver cirrhosis. Disorders of bile secretion. The role of autoimmune mechanisms in liver pathology.

Liver failure: cholestatic, hepatocellular, vascular, mixed. Manifestations of liver failure. Disorders of carbohydrate, protein, lipid, water-electron metabolism, hormonal regulation of the composition and physicochemical properties of blood in liver failure. Disorders of the barrier and detoxification function of the liver. Acute liver failure, hepatic coma.

The main syndromes in liver pathology. Jaundice, its types (suprahepatic, hepatic, subhepatic), causes, mechanisms of development, manifestations. Bilirubin metabolism disorders in various types of jaundice. Cholestasis, cholemia, acholia syndromes. Etiopathogenesis of cholelithiasis.

Hematological, endocrinological, hepatosplenic, hepatocerebral syndromes. Portal hypertension syndrome, pathogenic assessment of its symptoms.

The role of hepatotropic poisons in the pathogenesis of dystrophic, oncological and alcoholic liver damage. The role of liver pathology in digestive disorders.

Principles of prevention and therapy of liver pathology.

### **3.5. Pathophysiology of the kidneys**

Common elements in the etiology and pathogenesis of different renal function impairments. Impairments of renal hemodynamics, urine flow, renal parenchymal; disorders of urine formation neuro-humoral regulation; renal enzymopathy. Violation mechanisms of glomerular filtration, proximal and distal tubular reabsorption, tubular secretion and excretion; mixed violations.

Manifestations of renal function disorders. Changes in diuresis and urine composition, polyuria, oliguria, anuria, hypo- and hypersthenuria, izostenuriya pathological urine components of renal and extrarenal origin. Changes in the composition and physics-chemical properties of blood. Manifestations of hereditary tubulopathy.

The concept of glomerulopathies. Acute and chronic diffuse glomerulonephritis, pyelonephritis, etiology, pathogenesis.

Changes in diuresis in acute and chronic glomerulonephritis.

Characteristics of renal and extrarenal manifestations in glomerulonephritis.

Nephritis and nephrotic syndrome. Acute renal failure (acute kidney injury) and chronic kidney disease: etiology, pathogenesis, stages. Uremia. Principles of therapy of kidney pathology.

### **3.6. Pathophysiology of the endocrine system**

General etiology and pathogenesis of endocrine disorders. Disorders of the central mechanisms of regulation of endocrine glands. Excess, deficiency and imbalance of releasing and inhibitory factors of the diencephalon (liberins and statins); violation of feedback and self-regulation mechanisms in the neuroendocrine system, trans-, paraadenohypophyseal mechanisms of regulatory disorders. Psychogenic endocrinopathies.

Primary disorders of hormone synthesis in peripheral endocrine glands as a consequence of pathological processes in gland tissue, exhaustion due to prolonged hyperfunction, deficiency of components necessary for hormone synthesis, genetically determined defects in hormone biosynthesis. Iatrogenic endocrinopathies.

Peripheral (extra-glandular) mechanisms of disruption of hormone effects: disruption of hormone binding and "release" by blood proteins, blockades, excessive destruction and other metabolic disorders in tissues, absence or change in the properties of hormonal receptors in target cells.

Main types of endocrine disorders. Hypo-, hyper- and dysfunctional; mono- and pluri-glandular; partial and total endocrinopathies; early and late; primary, secondary, tertiary; absolute, relative, relatively absolute forms.

General characteristics of detection methods and treatment principles for endocrine disorders. The role of endocrine disorders in the etiology and pathogenesis of non-endocrine diseases.

Typical forms of dysfunction of individual endocrine glands. Pathology of the hypothalamic-pituitary system. Hyperfunction and hypofunction of the anterior pituitary gland. Hyper- and hypofunction of the posterior pituitary gland. Total pituitary insufficiency.

Pathophysiology of the adrenal glands. Typical forms of pathology (hypo- and hyperfunctional states), manifestations. Pathophysiology of the thyroid gland. Hypo- and hyperthyroidism, thyrotoxicosis. Cretinism, causes, clinical manifestations, consequences, principles of treatment.

Pathophysiology of the parathyroid glands: hypoparathyroidism, hyperparathyroidism.

Pathophysiology of the sex glands. Hypo- and hypergonadism in women and men, mechanisms of development, clinical manifestations, principles of treatment.

Disorders of the endocrine function of the pancreas.

Dyshormonal disorders of the mother's body, their importance in the development of fetal endocrinopathy, pregnancy.

### **3.7. Pathophysiology of the nervous system**

General etiology of nervous system disorders, exogenous and endogenous etiological factors, the importance of social conditions, primary and secondary disorders. The role of social factors in the occurrence of nervous system disorders, the importance of household intoxications; the possibility of medicinal origin of these

disorders. Inflammatory, vascular, post-traumatic and oncological diseases of the nervous system.

Typical disorders in the nervous system. The role of the generator of increased excitation, pathological dominant, pathology of excitation and inhibition, pathological deafferentation. Etiopathogenesis. Consequences. The role and consequences of mediator disorders in the occurrence of pathology of the nervous system.

Neurogenic movement disorders. Hypo- and hyperkinetic states. Central and peripheral paralysis and paresis. Comparative characteristics. Pathology of the extrapyramidal system. Hypokinetic-hypertonic syndrome (parkinsonism). Hyperkinetic-hypotonic syndrome (chorea). Manifestations of hyperkinesis. Mechanisms of occurrence. Epilepsy. Ataxia, its causes.

Neurogenic sensitivity disorders. Types of sensory disorders. Pain: mechanisms of development and biological significance.

Neurogenic vegetative disorders, types and main manifestations. The concept of vegetative dystonia. Neurogenic trophic disorders: neurogenic atrophies and dystrophies.

Disorders of higher nervous activity. Neuroses: definition of the concept and general characteristics. Biological and social aspects of neuroses. Main manifestations of neuroses.

## ACADEMIC DISCIPLINE « PATHOLOGICAL PHYSIOLOGY» CURRICULAR CHART

Section, topic #	Section (topic) name	Number of class hours			Literatures	Practical skill	Form of control	
		lectures	laboratory	Supervised student independent work			of practical skill	of current / intermediate assessment
<b>6 semester</b>								
	<b>Lectures</b>	<b>9</b>	<b>-</b>	<b>3</b>				
1.1.	Introduction. General doctrine of disease. General etiology and pathogenesis	1,5	-	1,5	1-6			Testing
1.3.	The role of reactivity, constitution and age in pathology. The role of heredity in pathology	1,5	-	1,5	1-6			Testing
2.2.	Pathology of cell	1,5	-	-	1-6			
2.3.	Inflammation	1,5	-	-	1-6			
2.4.	Infectious process. Fever	1,5	-	-	1-6			
2.7.	Tumor growth	1,5	-	-	1-6			
	<b>Laboratory classes</b>	<b>-</b>	<b>51</b>	<b>-</b>				
1.1.	Introduction to the academic discipline «Pathological Physiology». Subject, tasks, methods of pathological physiology	-	3	-	1-6			Survey, control test, abstracts
	General questions of the doctrine of disease. General etiology and pathogenesis	-	3	-	1-6			Survey, control work, electronic testing
1.2.	Damaging effect of electric current on the organism	-	3	-	1-6			Survey, testing, reports on practical work
	Damaging effect of ionizing radiation on the organism	-	3	-	1-6			Survey, testing, reports on practical work

1.3.	The role of reactivity, constitution and age in pathology	-	3	-	1-6			Survey, testing, abstracts, reports on practical work with their oral defense
	The role of heredity in pathology	-	3	-	1-6			Survey, testing, abstracts, reports on practical work with their oral defense
2.1.	Arterial and venous hyperemia. Ischemia. Stasis. Thrombosis, embolism, stasis	-	3	-	1-6			Survey, computer testing
	Microcirculation disorders. Final lesson on the section «Disorders of peripheral blood circulation and microcirculation»	-	3	-	1-6			Survey, testing
2.2.	Pathophysiology of cell	-	3	-	1-6			Survey, testing
2.3.	Inflammation. Vascular reactions at inflammation	-	3	-	1-6			Survey, testing, reports on practical work
	Inflammation. Phagocytic reaction at inflammation	-	3	-	1-6			Survey, testing, reports on practical work
2.4.	Infectious process. Fever	-	3	-	1-6			Survey, written reports on practical work, computer testing
2.5.	Hypoxia	-	3	-	1-6			Survey, testing
2.6.	Acid-base balance disorders	-	3	-	1-6	Pathogenic analysis of acid-base balance indicators with formulation of a conclusion on the causes, mechanisms of development and degree of compensation of typical forms of disorders	Solving situational tasks	Survey, testing

	Pathological physiology of water metabolism. Edema and dropsy. Final lesson on the topics covered in the section «Typical pathological processes»	-	3	-	1-6			Colloquium*
2.7.	Biological features of tumor growth. Methods of experimental reproduction of tumors. Etiology of tumors. Mechanisms of carcinogenesis	-	3	-	1-6			Survey, testing
	Relationships between tumor and organism. Principles of tumor treatment and prevention	-	3	-	1-6			Control work, reports on practical work with their oral defense. Credit
<b>7 semester</b>								
	<b>Lectures</b>	<b>9</b>	<b>-</b>	<b>3</b>				
3.1.	Pathological physiology of blood	-	-	1,5	1-6			Testing
3.2.	Pathological physiology of the external respiration	1,5	-	-	1-6			
3.3.	Pathophysiology of the cardiovascular system. Heart failure	1,5	-	1,5	1-6			Testing
3.4.	Pathological physiology of the digestion system. Pathological physiology of liver	1,5	-	-	1-6			
3.5.	Pathological physiology of kidneys	1,5	-	-	1-6			
3.6.	Pathological physiology of the endocrine system	1,5	-	-	1-6			
3.7.	Pathological physiology of the nervous system	1,5	-	-	1-6			
	<b>Laboratory classes</b>	<b>-</b>	<b>51</b>	<b>-</b>				
3.1.	Pathophysiology of the blood system. Periods and types of hematopoiesis and their disorders. Pathology of erythron. Pathological forms of erythrocytes and hemoglobin	-	3	-	1-6			Survey, testing

	Anemia. Erythrocytosis. Analysis of thematic hemograms	-	3	-				Survey, testing, reports on practical work
	Leukocyte pathology. Pathological forms of leukocytes. Leukocytosis, leukopenia. Analysis of thematic hemograms	-	3	-	1-6			Survey, testing, reports on practical work
	Hemoblastosis. Leukemoid reactions. Analysis of thematic hemograms	-	3	-				Survey, testing, reports on practical work
	Changes in total blood volume: hypo- and hypervolemia. Acute blood loss	-	3	-				Survey, testing, reports on practical work
	Hemostasis disorders	-	3	-				Survey, testing, reports on practical work
	Final lesson on the topic «Pathophysiology of the blood system»	-	3	-	1-6	Pathogenic analysis of hemograms of patients with various forms of blood system pathology, formulation of the conclusion	Solving situational tasks	Colloquium*
3.2.	Heart failure, its types. Overload and myocardial forms of heart failure	-	3	-	1-6			Survey, testing, reports on practical work
	Heart rhythm disturbances (arrhythmias), types, causes, mechanisms	-	3	-	1-6	Recognition of typical forms of heart rhythm disturbances according to electrocardiography data	Solving situational tasks	Survey, testing, reports on practical work
	Violations of the regulation of vascular tone. Arterial hypertension and hypotension.	-	3	-	1-6			Survey, testing, reports on practical work
	Final lesson on the topic «Pathophysiology of the cardio-vascular system»	-	3	-	1-6			Colloquium*

3.3.	Pathological physiology of the external respiration	-	3	-	1-6			Survey, testing, reports on practical work
3.4	Pathological physiology of liver and digestion	-	3	-	1-6	Analysis of typical situational tasks with the definition of symptoms that require immediate medical attention or allow the use of over-the-counter medications	Solving situational tasks	Survey, testing, reports on practical work
3.5.	Pathological physiology of kidneys	-	3	-	1-6	Analysis of typical situational tasks with the definition of symptoms that require immediate medical attention or allow the use of over-the-counter medications	Solving situational tasks	Survey, testing, reports on practical work
3.6.	Pathological physiology of the endocrine system	-	3	-	1-6			Survey, testing, reports on practical work
3.7.	Pathological physiology of the nervous system	-	3	-	1-6			Survey, testing, reports on practical work
	Final lesson on the topic «Pathophysiology of organs and systems»	-	3	-	1-6			Colloquium*
<b>Total hours</b>		<b>18</b>	<b>102</b>	<b>6</b>				Exam

\* This a mandatory form of current certification

## INFORMATION AND INSTRUCTIONAL UNIT

### Literature

#### Basic:

1. Pathophysiology : textbook for students of higher medical educational institutions of the III-IV accreditation levels / N. V. Krishtal [et al.]; ed. by. N. V. Krishtal, V. A. Mikhnev. – Kyiv : AUS Medicine Publishing, 2017. – 656 p.

#### Additional:

2. General and clinical pathophysiology : textbook for students of higher educational institutions, of IVth level of accreditation / A. V. Kubyshkin [et al.]; ed. by.: A. V. Kubyshkin, A. I. Gozhenko. – 2nd ed. – Vinnytsya : Nova Knyha Publishers, 2016. – 656 p.

3. Pathophysiology : textbook for students / P. F. Litvitsky, S. V. Pirozhkov, E. B. Tezikov. – Moscow : Geotar-Media, 2016. – 432 p.

4. Kumar, V. Robbins and Cotran Pathologic Basis of Disease. V. II / V. Kumar, A. K. Abbas, J. C. Aster. – India : Elsevier, 2015. – 1391 p.

5. Simeonova, N. K. Pathophysiology : textbook for students of higher medical educational institutions of the III-IV accreditation levels / N. K. Simeonova; ed. by. V. A. Mikhnev. – 2nd ed. – Kyiv : AUS Medicine Publishing, 2015. – 544 p.

#### Electronic courseware for the educational discipline «Pathological Physiology»:

6. <https://etest.bsmu.by/course/view.php?id=266>.

### METHODOLOGICAL RECOMMENDATIONS FOR THE ORGANIZATION AND PERFORMANCE OF STUDENT INDEPENDENT WORK IN THE ACADEMIC DISCIPLINE

The time allocated for independent work can be used by students for:

- preparing for lectures, laboratory classes;
- preparing for colloquiums, credit and exams in the academic discipline;
- carrying out research and creative tasks;
- preparing thematic reports, essays and presentations;
- taking notes on educational literature;
- preparing a review of scientific literature on a given topic;
- designing informational and demonstration materials (stands, posters, graphs, tables, newspapers, etc.);
- creating of the models and laboratory and teaching methods;
- compiling of the thematic collections of literary sources and internet sources.

### METHODOLOGICAL RECOMMENDATIONS FOR THE ORGANIZATION AND PERFORMANCE OF SUPERVISED STUDENT INDEPENDENT WORK IN THE ACADEMIC DISCIPLINE

#### APPROXIMATE LIST OF TASKS FOR SUPERVISED STUDENT INDEPENDENT WORK:

- preparation of thematic reports, abstracts, presentations;
- studying of the topics (issues) designed for independent work.

**FORMS OF CONTROL OF SUPERVISED STUDENT INDEPENDENT WORK:**  
testing.

**LIST OF AVAILABLE DIAGNOSTIC TOOLS**

The following forms are used for competence assessment:

survey;  
testing;  
colloquium;  
defense of an abstract (report);  
solving situational tasks;  
report on a practical work;

**LIST OF AVAILABLE TEACHING METHODS**

Linear (traditional) method;  
active (interactive) methods:  
Case-Based Learning (CBL).

**LIST OF PRACTICAL SKILLS**

Name of practical skills	Form of practical skills control
1. Pathogenic analysis of hemograms of patients with various forms of blood system pathology, formulation of a conclusion	Solving situational tasks
2. Pathogenic analysis of acid-base balance indicators with the formulation of a conclusion on the causes, mechanisms of development and degree of compensation of typical forms of disorders	Solving situational tasks
3. Recognition of typical forms of heart rhythm disturbances according to electrocardiography data	Solving situational tasks
4. Analysis of typical situational tasks with the definition of symptoms that require immediate medical attention or allow the use of over-the-counter medications	Solving situational tasks

**PROTOCOL OF THE CURRICULUM APPROVAL  
BY OTHER DEPARTMENTS**

Title of the discipline requiring approval	Department	Amendments to the curriculum in the academic discipline	Decision of the department, which designed the curriculum (date, protocol # )
Human Anatomy and Human Physiology	Pharmacology	Agreed. No comments or suggestions	Protocol # 2 of 20.05.2025
Pharmacology	Normal Physiology	Agreed. No comments or suggestions	Protocol # 2 of 20.05.2025
Biological Chemistry	Biological Chemistry	Agreed. No comments or suggestions	Protocol # 2 of 20.05.2025
Clinic Pharmacology	Clinic Pharmacology	Agreed. No comments or suggestions	Protocol # 2 of 20.05.2025

## COMPILERS/AUTHORS:

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S.A.Zhadan

Curriculum content, composition and the accompanying documents comply with the established requirements.

Head of the Office of Educational Activities of the Educational Institution «Belarusian State Medical University»

24.06. 2025

I.L.Kotovich

Methodologist of the Educational and Methodological department of the Office of Educational Activities of the Educational Institution «Belarusian State Medical University»

24.06. 2025

S.V.Zaturanova