

Ministry of Science and Higher Education of the Russian Federation
Federal State Autonomous Institution of Higher Education
“National Research Nuclear University “MEPhI”

INSTITUTE OF ENGINEERING PHYSICS FOR BIOMEDICINE

DEPARTMENT OF FUNDAMENTAL MEDICINE

APPROVED ИТС ИФИБ

Protocol No. 3.1

dated 30.08.2024

ACADEMIC COURSE OUTLINE

ПАТОФИЗИОЛОГИЯ / PATHOPHYSIOLOGY

Educational program track (speciality) [1] 31.05.01 General Medicine

Semester	Labour input, credits	Total course academic, hours	Lectures, hrs.	Practical sessions, hrs.	Laboratory sessions, hrs.	In the form of practical studies, hrs.	Independent studies, hrs.	Independent studies monitoring, hrs.	Course progress, Exam/Pass-fail exam/Term
5	3	108	18	0	54		36	0	PFE
6	3	108	14	0	34		60	0	PFE
7	4	144	20	0	40		30	0	Ex
Total	10	360	52	0	128	0	126	0	

ABSTRACT

During the course, students acquire knowledge about the general patterns and functional characteristics at the cellular, organ, system, and whole organism levels that determine the onset and course of disease. Students acquire practical and theoretical skills in understanding the mechanisms of resistance, pre-disease, recovery, and disease outcome. Mastering the discipline provides competence in understanding general nosology, local and general responses of the body to damage, patterns of development of typical pathological and adaptive processes, and issues of specific pathophysiology. In the process of studying the discipline, the clinical thinking of the future physician is developed on the basis of knowledge and understanding of the objective patterns of the course of the pathological process (disease).

1. ACADEMIC COURSE GOALS AND OBJECTIVES

The goal of the pathophysiology course is to develop competencies in assessing physiological conditions and pathological processes in the human body for professional purposes; understanding the etiology, general patterns, and specific mechanisms of the development and course of pathological processes in the human body, the ability to identify pathological processes and correlate them with the clinical manifestations of diseases, and the formation of the basics of clinical thinking using systematic knowledge about the nature of the disease, pathogenesis, outcomes of the disease, and principles of treatment and prevention of diseases.

Objectives of the discipline:

To form a system of knowledge about the etiology, general patterns, and specific mechanisms of development, course, and completion of pathological processes, conditions, and reactions in the human body;

To teach students the basic concepts and modern concepts of general nosology;

To develop skills and abilities in recognizing and identifying pathological processes and correlating them with the clinical manifestations of diseases, to teach methods of pathophysiological analysis of data on pathological syndromes, pathological processes, forms of pathology, and individual diseases;

Develop knowledge, abilities, and skills to formulate principles (algorithms, strategies) and methods for identifying, pathogenetic approaches to the treatment and prevention of pathological processes, conditions, reactions, and diseases, taking into account age characteristics;

Formation of the basics of clinical thinking using systematic knowledge about the nature of the disease, pathogenesis, outcomes of the disease, principles of treatment and prevention of diseases.

Formation of knowledge and skills to solve specific scientific research and applied scientific problems in the field of healthcare related to the study of etiology and pathogenesis, diagnosis, treatment, and prevention of diseases.

2. PLACE OF THE ACADEMIC COURSE IN THE MAIN HIGHER EDUCATION CURRICULUM

The discipline belongs to the basic part of the educational program.

To study the discipline, knowledge, skills, and abilities formed by previous disciplines are required: biology, medical and biological physics, chemistry, biochemistry, anatomy; histology, embryology, cytology, topographic anatomy, normal physiology, medical microbiology, and virology.

To gain a comprehensive understanding of the morphofunctional and physiological states and pathological processes in the human body for the purpose of solving professional tasks, it is advisable to study pathological physiology in parallel with disciplines such as pathological anatomy, immunology, pharmacology, propaedeutics of internal diseases, general surgery, radiological diagnostics, and diagnostic field training.

The study of this discipline is necessary for the knowledge, skills, and abilities formed by subsequent clinical disciplines included in the curriculum (internal medicine, surgical diseases, faculty therapy, occupational diseases; hospital therapy, hospital surgery, endocrinology; polyclinic therapy, infectious diseases, neurology, gynecology, urology, pediatric diseases, oncology, etc.).

3. DEVELOPED COMPETENCIES AND INTENDED LEARNING OUTCOMES

Universal and/or general professional competencies:

Competency code and title	Code and title of competency-based rubrics
ОПК-5 [1] – Capable of assessing morphofunctional and physiological states, as well as pathological processes in the human body to solve professional tasks.	3-ОПК-5 [1] – Know: - basic medical, pharmaceutical, and morphofunctional terminology, including Latin terms; - structure and functions of the human body, age-related, gender-specific, and individual characteristics of the structure and development of a healthy organism; - physical and chemical nature of processes occurring in a living organism; - patterns of vital activity of the organism, mechanisms of self-regulation and regulation; - features of regulation of the functioning of human body systems in pathological conditions; - patterns of occurrence, development, and outcome of typical pathological processes, the concept of sanogenesis; - etiology and pathogenesis of the most common diseases; - the concept of nosology, principles of disease classification; - principles of microorganism classification, their morphology, physiology, and impact on human health; - structure and functions of the human immune system. Y-ОПК-5 [1] – Be able to: - analyze mechanisms of disease development and manifestation; - recognize morphological and functional changes in cells, tissues, organs, and systems of the human body; - use basic physical-chemical and other natural science concepts and methods in solving professional tasks; - determine the cause of death and formulate a pathological diagnosis. B-ОПК-5 [1] – Possess skills in: - conducting microscopy and analyzing microscopic specimens; - correlating morphological and clinical manifestations of diseases; - assessing morphofunctional, physiological states, and pathological processes in humans; - clinical-anatomical analysis of autopsy results.

4. PEDAGOGIC POTENTIAL OF THE COURSE

Pedagogic tracks/objectives	Pedagogic goals (code)
Intellectual education	Establishing conditions for: formation of culture of intellectual work (B11)
Professional education	Establishing conditions for: formation of motivation to improve the quality of medical care to the population and the desire to follow the rules and norms of interaction between the doctor, colleagues and the patient, contributing to the creation of the most favorable environment for the patient's recovery (B34)

5. ACADEMIC COURSE STRUCTURE AND CONTENT

Academic course sections, their scope, terms of study and assessment:

No.	Academic course section name	Weeks	Lectures/ Practical (seminars)/ Laboratory sessions, hrs.	Compulsory current assessment (form*, week)	Maximum grade per section**	Section assessment (form*, week)	Competency-based rubrics
	<i>5 Semester</i>						
1	The First Section	1-8	9/0/27	T-8 (25)	25	T-8	3-ОПК-5, У-ОПК-5, В-ОПК-5
2	The Second Section	9-15	9/0/27	T-15 (25)	25	T-15	3-ОПК-5, У-ОПК-5, В-ОПК-5
	<i>Totals for 5 Semester</i>		18/0/54		50		
	Assessment events for 5 Semester				50	PFE	3-ОПК-5, У-ОПК-5, В-ОПК-5
	<i>6 Semester</i>						
1	The First Section	1-4	3/0/10	T-4 (12)	12	T-4	3-ОПК-5, У-ОПК-5, В-ОПК-5
2	The Second Section	5-8	4/0/8	T-8 (12)	12	T-8	3-ОПК-5, У-ОПК-5, В-ОПК-5
3	The Third Section	9-12	3/0/8	T-12 (12)	12	T-12	3-ОПК-5, У-ОПК-5, В-ОПК-5
4	The Fourth section	13-15	4/0/8	T-15 (14)	14	T-15	3-ОПК-5, У-ОПК-5, В-ОПК-5
	<i>Totals for 6 Semester</i>		14/0/34		50		
	Assessment events for 6 Semester				50	PFE	3-ОПК-5, У-ОПК-5, В-ОПК-5

	<i>7 Semester</i>						
1	The First Section	1-5	10/0/20	T-5 (25)	25	T-5	3-ОПК-5, У-ОПК-5, В-ОПК-5
2	The Second Section	6-15	10/0/20	T-10 (25)	25	T-10	3-ОПК-5, У-ОПК-5, В-ОПК-5
	<i>Totals for 7 Semester</i>		20/0/40		50		
	Assessment events for 7 Semester				50	Ex	3-ОПК-5, У-ОПК-5, В-ОПК-5

* – abbreviated name of assessment

** – 100 maximum points per semester including a pass/fail exam and (or) an exam

Abbreviated current assessment forms and section assessment

Abbreviation	Full name
T	Testing
PFE	Pass/fail examination
Ex	Exam

SYLLABUS

Weeks	Topics / Content	Lect., hrs.	Pr./sem., hrs.	Lab., hrs.
	<i>5 Semester</i>	18	0	54
1-8	The First Section	9	0	27
1 - 3	General pathophysiology. The place of physiology in the system of higher medical education. The significance of pathophysiological research results for the development of preventive healthcare, the improvement and creation of new methods and means of diagnosis and treatment of diseases. Methods of pathophysiology. Modern methods used in pathophysiological experiments. The role of domestic and foreign scientists in the development of pathophysiology. Structure of the pathophysiology course: general pathophysiology (general nosology; typical pathological processes); specific pathophysiology (pathophysiology of organs and physiological systems). Causes and conditions of disease onset; their dialectical interrelationship. The concept of external and internal causes and risk factors of disease. Pathogenic factors of the external environment. The damaging effect of physical factors. The damaging effect of mechanical influences, electric current, ionizing radiation, and space flight factors. Pathogenic effects of chemical factors: exogenous and endogenous intoxication. Alcoholism, substance abuse, drug addiction: characteristics of the concept, types, etiology, pathogenesis, manifestations, consequences. Pathogenic effects of biological factors; viruses,	All		
		3	0	9
		Online		
		0	0	0

	rickettsiae, bacteria, and parasites as causes of disease. Psychogenic pathogenic factors. The importance of social factors in maintaining health and the onset of human diseases. Damage - the initial link in pathogenesis. Levels of damage: submolecular, molecular, subcellular, cellular, organ-tissue, organismic. Manifestations of damage at different levels of organism integration. The unity of functional and structural changes in the pathogenesis of diseases. Cause-and-effect relationships in pathogenesis; primary and secondary damage. Localization and generalization of damage; local and general reactions to damage, their interrelationship. Leading links in pathogenesis; “vicious circles.” Outcomes of diseases. Complete and incomplete recovery. Remission, relapse, complications. Protective, compensatory, and restorative reactions of the body. Mechanisms of recovery. Pathogenetic principles of disease therapy.			
4 - 8	Typical forms of pathological processes Types of peripheral blood circulation disorders. Arterial hyperemia. Neurogenic and humoral mechanisms of local vasodilation; neuromuscular mechanism of arterial hyperemia. Changes in microcirculation during arterial hyperemia. Types, symptoms, and significance of arterial hyperemia. Ischemia. Causes of increased resistance to blood flow in arteries. Vascular compression, angiospasm, thrombosis, embolism (types, significance in the development of other pathological processes), sclerotic changes in artery walls. Microcirculation in ischemia. Symptoms and consequences of ischemia. Significance of tissue and organ function, shunting, and collateral circulation in the outcome of ischemia. Heart attack as a consequence of ischemia. Venous hyperemia, its causes. Microcirculation in the area of venous stasis. Symptoms and significance of venous hyperemia. Stasis. Ischemic, congestive, and “true” capillary stasis. Typical forms of blood and lymph microcirculation disorders: intravascular, transmural, extravascular. Their causes, possible mechanisms of manifestation, and consequences. The concept of capillary trophic insufficiency. Disorders of blood rheological properties as a cause of organ-tissue blood circulation and microcirculation disorders. Changes in blood viscosity. Hemoconcentration. Impaired suspension stability and deformability of erythrocytes, aggregation and agglutination of platelets and erythrocytes, “sludge” phenomenon. Impaired blood flow structure in microvessels. Syndrome of nonspecific hemorheological disorders. Etiology of inflammation. Main components of the pathogenesis of the inflammatory process. Alteration. Changes in function, metabolism, the state of cell membranes and cell organelles; mechanisms of increased permeability. Release and activation of biologically active substances—mediators of inflammation; their types, origin, and significance in the dynamics of the development and completion of inflammation. The relationship between various mediators. Exudation.	All		
		6	0	18
		Online		
		0	0	0

	Reactions of the microcirculatory vessels. Changes in tone, permeability of vessel walls, and blood flow; their stages and mechanisms. Changes in the rheological properties of blood in the focus of inflammation; protein composition and physicochemical properties of plasma proteins. Proliferation. The reparative stage of inflammation; mechanisms of proliferation processes; its stimulators and inhibitors. Local and general signs of inflammation. Types of inflammation; their classification. Chronic inflammation. General patterns of development. Pathogenetic features of acute and chronic inflammation. The role of reactivity in the development of inflammation; the connection between local and general phenomena in inflammation; the significance of immune responses in the inflammatory process. Inflammation and allergy. The dialectical relationship between damage and adaptive responses in the inflammatory process. Outcomes of inflammation. The biological significance of inflammation. The barrier role of inflammation, mechanisms of its provision. The concept of the systemic action of inflammatory mediators and its pathogenicity. The role of the systemic action of inflammatory mediators in the pathogenesis of shock and sepsis. Principles of anti-inflammatory therapy. The development of inflammation in ontogenesis. Etiology and pathogenesis of fever. Fever as a component of the acute phase response. Infectious and non-infectious fever. Pyrogenic substances: exopyrogens (bacterial lipopolysaccharides) and endopyrogens (IL-1, IL-6, TNF). Mechanism of action of pyrogens. Mediators of fever. Stages of fever. Thermoregulation at different stages of fever. Types of fever reactions. Dependence of fever development on the properties of the pyrogenic factor and the reactivity of the body. Participation of the nervous, endocrine, and immune systems in the development of fever. Biological significance of fever. Principles of antipyretic therapy. The concept of pyrotherapy. Antipyretics. Differences between fever and exogenous overheating and other types of hyperthermia			
9-15	The Second Section	9	0	27
9 - 10	Immunopathological processes. Immunopathological processes. Concept of the structure, function, and role of the immunobiological surveillance system (IBS). The immune system and factors of nonspecific protection of the body as components of the IBS. Typical forms of IBS pathology. Immunodeficiency states (IDS). Primary (hereditary and congenital) immunodeficiencies. Predominant deficiency of the cellular link of immunity (T-system): congenital thymus hypoplasia, purine nucleoside phosphoridase deficiency. Immunodeficiencies with impaired antibody production (B-system defects): agammaglobulinemia, deficiency of certain classes of immunoglobulins. IDS caused by defects in the A-cells of the immune system (Chediak-Higashi syndrome). Combined immunodeficiencies (damage to the T, B, and A	All		
		3	0	5
		Online		
		0	0	0

	systems): reticular dysgenesis, “Swiss type,” enzyme deficiency forms. Acquired immunodeficiency and immunosuppression in infections, radiation damage, protein loss, intoxication, alcoholism, tumors, aging; iatrogenic immunodeficiencies. Acquired immunodeficiency syndrome (AIDS). Etiology, routes of infection, pathogenesis, clinical forms, principles of prevention and treatment.			
11 - 12	Allergic reactions. Definition and general characteristics of allergies. The relationship between allergies and immunity, allergies and inflammation. Exogenous and endogenous allergens; their types. The significance of hereditary predisposition to allergies: Types of allergic reactions, their classification. Etiology and pathogenesis of allergic diseases. Types I, II, III, IV, and V. Characteristics of allergens, stages, mediators, and pathogenetic differences between allergic diseases of types I, II, III, IV, and V. Clinical forms. Methods of diagnosis, prevention, and treatment of allergic diseases. Autoimmune diseases. Etiology, pathogenesis, clinical forms. The role of external and internal factors in the pathogenesis of autoimmune diseases. Principles of diagnosis, prevention, and treatment.	All		
		3	0	10
		Online		
		0	0	0
13 - 14	Typical tissue growth disorders. Etiology of tumors; physical and chemical blastomogenic factors, oncogenic viruses. Ionizing radiation as a blastomogenic factor. Blastomogenic effect of UV rays, thermal and mechanical factors. Chemical carcinogens, their classification; procarcinogens and final carcinogens. Stages of initiation and promotion in chemical carcinogenesis. Oncoviruses, their classification. Routes of oncovirus spread. The role of viral oncogenes in the tumorigenic action of oncoviruses. Human tumors caused by oncoviruses. Pathogenesis of tumors. Modern concepts of the molecular mechanisms of carcinogenesis. The significance of oncogenes, the role of oncoproteins in carcinogenesis, their types. The significance of hereditary factors, gender, age, chronic diseases in the occurrence and development of tumors in humans. Precancerous conditions. Malignant and benign tumors. Antitumor resistance of the body. Characteristics of anticarcinogenic, antimutational (antitransformational), and anticellular mechanisms of antitumor resistance of the body. Interaction between the tumor and the body. Tumor cachexia, paraneoplastic syndromes. Pathophysiological basis for the prevention and treatment of tumor growth	All		
		3	0	5
		Online		
		0	0	0
15	Pathophysiology of water and electrolyte metabolism. Ion metabolism disorders. Imbalance in the content and ratio of sodium, potassium, calcium, magnesium, and trace elements in body fluids and cells. Imbalance in the distribution and exchange of ions between intracellular and extracellular compartments. The main causes and mechanisms of ion homeostasis disorders. The relationship between water, ion, and acid-base balance. Disorders of metabolism and physiological	All		
		0	0	7
		Online		
		0	0	0

	functions in the most common forms of ion metabolism disorders. Hypohydration: hyper-, iso-, and hypoosmolar hypohydration. Causes, pathogenetic features, symptoms, and consequences of hypohydration. Principles of correction. Hyperhydration. Hyper-, iso-, and hypoosmolar hyperhydration. Causes, pathogenetic features, symptoms, and consequences of hyperhydration. Edema. Pathogenetic factors of edema: “mechanical” (hemodynamic, lymphogenic), “membrane-related,” “oncotic,” “osmotic,” dynamic and mechanical lymphatic insufficiency; disorders of neurohormonal regulation of water-electrolyte balance. Pathogenesis of cardiac, renal, inflammatory, toxic, allergic, and starvation edema. Local and general disorders in edema. Principles of edema therapy. Experimental models of edema			
	6 Semester	14	0	34
1-4	The First Section	3	0	10
1 - 4	Pathophysiology of the cardiovascular system and external respiration system. Types of respiratory failure according to etiology, course, degree of compensation, and pathogenesis. Extrapulmonary and pulmonary etiological factors of respiratory failure. Disorders of non-gas exchange functions of the lungs. Changes in blood gas composition and acid-base status in respiratory failure in the compensation and decompensation stages. Ventilation forms of respiratory failure. Etiology and pathogenesis of obstructive, restrictive, and mixed types of pulmonary ventilation disorders. Methods of functional diagnosis of pulmonary ventilation disorders: spirometry, pneumotachometry, flow/volume loop index, assessment of lung elasticity. Diffusion forms of DH. Causes, manifestations, assessment of gas diffusion disorders through the alveolar-capillary membrane. Pulmonary blood flow disorders. The relationship between ventilation and perfusion in normal and pathological conditions: changes in the ventilation-perfusion index, its assessment. Alveolar dead space, alveolar-venoarterial shunting. Respiratory regulation disorders. Pathological forms of breathing: Etiology and pathogenesis of pathological forms of breathing. Characteristics of the concept of hypoxia. Hypoxia as a state of absolute or relative insufficiency of biological oxidation The role of hypoxia in the pathogenesis of various pathological processes and diseases. The resistance of individual organs and tissues to oxygen deprivation. Principles of classification of hypoxic conditions. Types of hypoxia. Etiology and pathogenesis of the main types of hypoxia: exogenous, respiratory, circulatory, hemic, tissue. Hypoxia in the separation of oxidation and phosphorylation. Overload hypoxia. The concept of hypoxia as a consequence of a deficiency of biological oxidation substrates. Mixed forms of hypoxia. Indicators of the gas composition of arterial and venous blood in certain types of hypoxia. Emergency and long-term adaptive responses to hypoxia; their mechanisms. Pathophysiological	All		
		4	0	8
		Online		
		0	0	0

	basis for the prevention and treatment of hypoxic conditions. Circulatory disorders in heart function disorders. Heart failure, its types. Myocardial form of heart failure, its etiology and pathogenesis. Non-coronary forms of heart damage: with a general deficiency of oxygen and biological oxidation substrates in the body, significant overload of the heart. General hypoxia, intoxication, hormonal and metabolic disorders, autoimmune processes, disorders of central cardiac regulation, pathological viscerocardiac reflexes as causes of myocardial heart failure. The significance of the psychoemotional factor. Overload form of heart failure: overload of blood volume and pressure in the heart chambers, causes of heart overload. Heart valve defects, their main types. Mechanisms of urgent and long-term adaptation of the heart to overload. Physiological and pathological myocardial hypertrophy, characteristics of a hypertrophied heart, mechanisms of its decompensation. Heart function disorders in pericardial pathology; acute cardiac tamponade. Manifestations of heart failure. Coronary insufficiency, absolute and relative, reversible and irreversible. The concept of reperfusion cardiac syndrome in reversible coronary insufficiency. Ischemic heart disease, its forms, causes, and mechanisms of development. Angina pectoris. Myocardial infarction, metabolic disorders, electrogenic and contractile properties of the myocardium in the area of ischemia and beyond. Pathophysiological explanation of electrocardiographic signs of ischemia and myocardial infarction, ischemic and reperfusion damage to the myocardium. Complications and outcomes of angina pectoris and myocardial infarction. Cardiac arrhythmias: their types, causes, mechanisms, and electrocardiographic manifestations. Disorders of general and coronary circulation in arrhythmias; heart failure in arrhythmias. Cardiac fibrillation and defibrillation, the concept of artificial pacemakers. Arterial hypertension. Primary arterial hypertension (hypertensive disease), its etiology and pathogenesis, forms and stages; factors stabilizing elevated blood pressure. Secondary ("symptomatic") arterial hypertension, its types, causes, and mechanisms of development. Features of hemodynamics in various types of arterial hypertension. Complications and consequences of arterial hypertension. Arterial hypotension, its types, causes, and mechanisms of development. Acute and chronic arterial hypotension. Hypotonic disease. Collapse, its types. Manifestations and consequences of hypotensive states			
5-8	The Second Section	4	0	8
5 - 8	Pathophysiology of the gastrointestinal tract, liver, and kidneys General etiology and pathogenesis of digestive system disorders. Infectious processes in the digestive system. Disorders of appetite, salivation, chewing, swallowing, and esophageal function. Disorders of the reservoir, secretory, and	All		
		4	0	8
		Online		
		0	0	0

	motor functions of the stomach. Quantitative and qualitative disorders of the secretory function of the stomach. Types of pathological secretion. Hypo- and hyperkinetic states of the stomach. Disorders of gastric emptying: belching, heartburn, nausea, vomiting. The relationship between secretory and motor disorders. Acute and chronic gastritis. Disorders of the small and large intestine. Disorders of secretory function. The significance of enterocyte damage, pancreatic achilia, acholia; the role of gastrointestinal hormones. Disorders of cavity and parietal digestion; malabsorption. Disorders of intestinal motility. Diarrhea, constipation, intestinal obstruction. Disorders of the intestinal barrier function; intestinal autointoxication; colic, dysbacteriosis. Enteritis, colitis. Peptic ulcer disease and symptomatic ulcers of the stomach and duodenum. Theories of ulcerogenesis. Modern views on the etiology and pathogenesis of peptic ulcer disease. Principles of treatment. Disorders of pancreatic secretory function; acute and chronic pancreatitis. General etiology of liver diseases. Liver failure. Pathogenetic variants of liver failure: cholestatic, hepatic-cellular, vascular, mixed. Characteristics of the concept of "jaundice." Types, causes, differential diagnosis of "suprahepatic," "hepatic," and "subhepatic" jaundice. Hepatocellular insufficiency syndrome, causes, manifestations, diagnostic methods. Disorders of carbohydrate, protein, lipid, water-electrolyte metabolism, regulation of blood composition and physicochemical properties in liver failure. Disorders of the barrier and detoxification functions of the liver. Hepatic coma. Disorders of the main processes in the kidneys: filtration, excretion, reabsorption, secretion, and incresion. Etiology and pathogenesis of disorders of the glomeruli and renal tubules. Renal symptoms. Changes in daily diuresis (poly-, oligo-, anuria), changes in relative urine density, hypo- and isostenuria, their causes and diagnostic significance. Assessment of the concentrating function of the renal tubules. "Urinary syndrome." Proteinuria, hematuria, leukocyturia, their types, causes, diagnostic significance. Other pathological components of urine of renal and extrarenal origin. Extrarenal symptoms and syndromes in kidney diseases. Pathogenesis and significance of azotemia, anemia, arterial hypertension, edema. Nephrotic syndrome. Types, pathogenesis. Glomerulonephritis, acute and chronic pyelonephritis. Etiology, pathogenesis, clinical manifestations, principles of treatment. Acute and chronic renal failure. Forms, etiology, pathogenesis, stages, treatment principles. The importance of hemodialysis in treatment, its principles. Kidney stones. Etiology, pathogenesis, clinical manifestations			
9-12	The Third Section	3	0	8
9 - 12	Pathology of the blood system. Characteristics of absolute and relative, hereditary and acquired erythrocytoses. Their etiology, pathogenesis, clinical manifestations, consequences. The significance of hormonal and humoral factors in the development of erythrocytoses.	All		
		4	0	8
		Online		
		0	0	0

	Anemia. Hypoxic syndrome is the main pathogenetic factor in anemia. Types of anemia; characteristics according to etiology and pathogenesis, type of hematopoiesis, color index, bone marrow regenerative capacity, size and shape of erythrocytes. Etiology, pathogenesis, clinical and hematological manifestations, principles of diagnosis and treatment of anemia: dyserythropoietic (B12-, folate-deficient, iron-deficient, sideroblastic, hypo- and aplastic), hemolytic, posthemorrhagic. Leukocytosis, leukopenia (including agranulocytosis), aleukia, their types, causes, and mechanisms of development. Changes in the leukocyte formula. Disorders of the structure and function of individual types of leukocytes, their role in pathological processes. Leukemoid reactions. Types of leukemoid reactions, their etiology, pathogenesis, changes in hematopoiesis and the morphological composition of peripheral blood. Differences from leukemias, significance for the body. Leukemias: characteristics of the concept, principles of classification. Etiology of leukemia and hematosarcoma, the role of viruses, chemical carcinogens, and ionizing radiation in their development. Atypical leukemia; its morphological, cytochemical, cytogenetic, and immunological characteristics. Features of hematopoiesis and peripheral blood cell composition in different types of leukemia and hematosarcoma. Major disorders in the body in hemoblastoses, their mechanisms. Principles of diagnosis and treatment of hemoblastoses.			
13-15	The Fourth section	4	0	8
13 - 15	Pathophysiology of the nervous and endocrine systems. Hereditary pathologies. Pathophysiology of the nervous and endocrine systems. Hereditary pathologies. General etiology and mechanisms of damage to the nervous system. Disorders of the central nervous system functions in cases of changes in blood electrolyte composition, failure of other organs (kidneys, liver). Brain damage caused by disturbances in cerebral blood flow. Disorders of the nervous system caused by myelin disorders. Typical forms of neurogenic sensory and motor disorders. Diseases of the “motor units.” Factors determining the intensity of pain sensations and reactions. The biological significance of pain as a signal of danger and damage. Typical pathological processes in the nervous system. Inhibition deficiency, disinhibition. Denervation syndrome. Deafferentation. Spinal shock. Neurodystrophy. Disorders of the autonomic nervous system. Damage to the hypothalamus, sympathetic and parasympathetic innervation. Autonomic neuroses. General etiology and pathogenesis of endocrinopathies. Disorders of central regulatory mechanisms. Disorder of transhypophyseal regulation of endocrine glands. Disorder of parahypophyseal regulation. The role of the feedback mechanism. Pathological processes in the endocrine glands: infectious processes and intoxications; tumor processes;	All		
		4	0	8
		Online		
		0	0	0

	genetically determined defects in hormone biosynthesis. Peripheral (extraglandular) mechanisms of hormone effect disruption. Disorders of hormone binding and “release” by proteins. Blockade of circulating hormones and hormone receptors. The role of autoimmune mechanisms in the development of endocrine disorders. Genetic diseases: mono- and polygenic. General patterns of pathogenesis of genetic hereditary diseases. Storage diseases. The role of DNA repair system disorders. Typical transmission of hereditary diseases. Examples of diseases transmitted in an autosomal dominant or autosomal recessive manner. The concept of gene penetrance and expressivity. Diseases with a hereditary predisposition, their genetic markers. Chromosomal diseases, polyploidy, aneuploidy (syndromes: Turner, trisomy X, Klinefelter, Down), their manifestations and pathogenetic features.			
	<i>7 Semester</i>	20	0	40
1-5	The Fift Section	10	0	20
1	Ischemic and reperfusion injury syndrome of the brain. Ischemic and reperfusion injury syndrome of the brain. The main links in the pathogenesis of cerebral ischemia: decreased energy production, inhibition of the aerobic pathway of glucose utilization, activation of the anaerobic pathway of glucose utilization, impaired active transport of various ions across membranes with the opening of agonist-dependent Ca ²⁺ channels and an increase in the concentration of free cytosolic calcium in neurons, and abnormalities in the function of excitotoxic mediators of excitation. Factors determining the severity of hypoxic brain damage. The effect of changes in blood coagulation properties on the development of cerebral ischemia	All		
		3	0	5
		Online		
		0	0	0
2	Ischemic and reperfusion injury syndrome of the myocardium. Ischemic and reperfusion injury syndrome of the myocardium. Ischemic heart disease, forms, causes, risk factors, mechanism of development. Ischemic myocardial damage, stages: involvement of major pathogenetic factors, ischemic myocardial damage, inhibition of major metabolic pathways, role of Ca ²⁺ and the lipid triad in ischemic myocardial damage. Reperfusion syndrome. Pathogenesis. The role of the lipid triad and Ca ²⁺ in the mechanism of development. Protective mechanisms in ischemia. The role of glycolysis activation, adenylyl nucleotides, and antioxidant protection in limiting ischemic myocardial damage. Cardiogenic shock.	All		
		2	0	5
		Online		
		0	0	0
3	Metabolic syndrome. Cachexia Etiology and pathogenesis of metabolic syndrome, algorithms for diagnosis and treatment. Cachexia as a typical clinical syndrome: etiology, pathogenesis of wasting.	All		
		2	0	5
		Online		
		0	0	0
4 - 5	Extreme and terminal conditions. Extreme and terminal conditions: basic concepts, etiology, principles of therapy for extreme conditions. Characteristics of	All		
		3	0	5
		Online		

	the main extreme conditions. Characteristics of the stages of dying. Principles of therapy for terminal conditions.	0	0	0
6-15	The Second Section	10	0	20
6 - 7	DIC syndrome. THS syndrome. Thrombohemorrhagic syndromes. Disorders in the walls of microvessels. Microcirculation disorders and sludge syndrome. Disseminated intravascular coagulation syndrome. Thrombotic syndrome. Hemorrhagic diseases and syndromes.	All		
		3	0	5
		Online		
		0	0	0
8 - 9	Hypertensive syndrome. Pneumonia. Hypertensive syndrome. Pneumonia. Pneumonia: concept, types, etiology, clinical picture. Definition of the concepts of pneumonia and pneumonitis. Classification of pneumonia. Clinical picture of pneumonia. Pathogenesis, diagnosis, treatment of pneumonia.	All		
		2	0	5
		Online		
		0	0	0
10 - 11	Airway obstruction syndrome. Acute lung injury syndrome. Airway obstruction syndrome. Upper airway obstruction. Main clinical manifestations of bronchial obstruction syndrome. Chronic obstructive pulmonary disease. Treatment of COPD. Acute lung injury syndrome. Pathogenesis of ARDS. Conditions for providing medical care and its etiopathogenetic significance. Artificial lung ventilation, respiratory support. Pharmacotherapy. Transferring a patient from mechanical ventilation to independent breathing.	All		
		2	0	5
		Online		
		0	0	0
12 - 15	Adrenal insufficiency syndrome. Hyperthyroidism and hypothyroidism syndromes. Adrenal insufficiency syndrome. Hyperthyroidism and hypothyroidism syndromes. The main physiological effects of adrenal corticosteroids. Adrenal insufficiency: concept, types, characteristics of chronic adrenal insufficiency. Diagnosis of chronic adrenal insufficiency. Characteristics of acute adrenal insufficiency. Hypothyroidism syndrome. Biosynthesis of thyroid hormones. Characteristics of hypothyroidism. Main types, pathogenesis, clinical presentation, diagnosis, and treatment of hypothyroidism. Hyperthyroidism syndrome. Classification of thyrotoxicosis. Characteristics, diagnosis, and treatment of the disease.	All		
		3	0	5
		Online		
		0	0	0

Abbreviated names of online options:

Abbreviation	Full name
EC	E-course
FtM	Full-text material
FtL	Full-text lectures
VM	Video materials
AM	Audio materials
Prs	Presentations
T	Tests
ERM	E-reference materials
IS	Interactive site

LABORATORY (LAB) SESSIONS TOPICS

Weeks	Topics / Content
	<i>5 Semester</i>
1 - 8	General pathophysiology. 1. Typical forms of pathological processes 2. Immunopathological processes 3. Allergic reactions
9 - 15	General pathophysiology 2 1. Typical tissue growth disorders 2. Pathophysiology of water-electrolyte balance.
	<i>6 Semester</i>
1 - 4	Pathophysiology of the cardiovascular system and external respiration system. 1. Pathophysiology of the respiratory system. 2. Hypoxia. 3. Pathophysiology of the cardiovascular system.
5 - 8	Pathophysiology of the gastrointestinal tract, liver, and kidneys 1. Digestive system disorders 2. Pathophysiology of liver diseases 3. Disturbances of the main processes in the kidneys.
9 - 12	Pathology of the blood system. Pathology of the blood system. 1. Erythrocytosis. Anemia. Hypoxic syndrome. 2. Leukocytosis, leukopenia. Leukemoid reactions. 3. Main disorders in the body associated with hemoblastoses and their mechanisms. Principles of diagnosis and treatment of hemoblastoses.
13 - 15	Pathophysiology of the nervous and endocrine systems. Hereditary pathologies. 1. Nervous system damage 2. Endocrinopathies 3. Genetic diseases
	<i>7 Semester</i>
	Syndromes 1 1. Ischemic and reperfusion injury syndrome of the brain. 2. Ischemic and reperfusion injury syndrome of the myocardium. 3. Metabolic syndrome. Cachexia 4. Extreme and terminal conditions.
	Syndromes 2 1. DIC syndrome. TSS syndrome. 2. Hypertensive syndrome. Pneumonia. 3. Airway obstruction syndrome. Acute lung injury syndrome. 4. Adrenal insufficiency syndrome. Hyperthyroidism and hypothyroidism syndromes.

6. EDUCATIONAL TECHNOLOGIES

The following educational technologies are used in classroom sessions:

Traditional: information lectures; practical sessions.

Problem-based learning technologies: solving situational problems

Independent classroom work on the discipline is carried out in practical classes under the direct supervision of the teacher and according to his or her instructions. Practical work includes various experimental tasks in accordance with all the main sections of the theoretical course and is carried out

independently in the department's classrooms. Independent work outside the classroom is carried out by the student at the instructor's request, but without their direct participation. The main types of independent work by students without the participation of teachers are: - mastering the content of lecture notes based on the educational literature recommended by the lecturer, including information educational resources (electronic textbooks, electronic libraries, etc.); - preparation for practical work, its design.

7. ASSESSMENT TOOLKIT

The assessment toolkit ensures verification of the intended learning outcomes achievement (competency-based rubrics) using current, midterm and interim assessment of the course.

The link between developed competencies and their assessment is presented in the following table:

Competency	Achievement rubrics	Assessment activity (Syl 1)	Assessment activity (Syl 2)	Assessment activity (Syl 3)
ОПК-5	3-ОПК-5	PFE, T-8, T-15, T-8	PFE, T-4, T-8, T-12, T-15, T-4, T-15	Ex, T-5, T-10
	У-ОПК-5	PFE, T-8, T-15, T-15	PFE, T-4, T-8, T-12, T-15, T-8	Ex, T-5, T-10, T-5
	В-ОПК-5	PFE, T-8, T-15	PFE, T-4, T-8, T-12, T-15, T-12	Ex, T-5, T-10, T-10

Educational achievement rubrics scales

The scale of each assessment activity varies from 0 to the maximum established point, inclusive. The final assessment of the course is performed on a 100-point scale and represents the sum of the points earned by the student in the section assessments, framework of current and interim assessment.

Sections and interim assessments are considered passed when the student achieves a minimum score equal to 60% of the maximum. The final grade is assigned only upon passing all sections and the interim assessment.

The final grade is assigned in accordance with the following scale:

Total score	Rating on a 4-point scale	Pass/fail examination	ECTS assessment
90-100	5 – « <i>excellent</i> »	« <i>pass</i> »	A
85-89	4 – « <i>good</i> »		B
75-84			C
70-74			D
65-69			
60-64	3 – « <i>satisfactory</i> »		E
below 60	2 – « <i>fail</i> »	« <i>fail</i> »	F

An “excellent” grade indicates a deep and solid mastery of the program material by a student who presents their answers consistently, clearly, and logically, is able to closely link theory with practice, and uses materials from monographic literature in their answers.

A “good” grade corresponds to a student’s solid knowledge of the material, who presents their answers competently and to the point, without any significant inaccuracies.

A “satisfactory” grade corresponds to the basic level of mastery of the material by the student, in which the main material has been mastered, but its details have not been assimilated, the answers contain inaccuracies, insufficiently correct wording and logical inconsistencies.

A grade “pass” corresponds to at least a basic level of mastery of the program material, in which the student possesses the necessary knowledge, skills, and abilities, and is able to apply theoretical principles to solve typical practical problems.

A grade “fail” is given to a student who lacks a significant understanding of the curriculum material, makes significant errors in their answers, or fails all required assignments. These students are generally unable to continue their studies without additional classes.

8. ACADEMIC COURSE EDUCATIONAL, METHODOLOGICAL AND INFORMATIONAL SUPPORT

CORE READING:

1. ЭИ Л64 Патопфизиология : учебник, Литвицкий П.Ф., Москва: ГЭОТАР-Медиа, 2023
2. ЭИ Л 64 Патопфизиология = Pathophysiology : лекции, тесты, задачи : , Тезиков Е.Б., Литвицкий П.Ф., Пирожков С.В., Москва: ГЭОТАР-Медиа, 2014
3. ЭИ Л 64 Патопфизиология = Pathophysiology : лекции, тесты, задачи : Министерство образования и науки РФ Рекомендовано ГОУ ВПО "Московская медицинская академия имени И.М. Сеченова" в качестве учебного пособия для студентов учреждений высшего профессионального образования, обучающихся по специальностям 31.05.01 "Лечебное дело", 31.05.02 "Педиатрия", 32.05.01 "Медико-профилактическое дело", 31.05.03 "Стоматология" по дисциплине "Патопфизиология", Тезиков Е.Б., Литвицкий П.Ф., Пирожков С.В., Moscow: ГЭОТАР-Медиа, 2016

FURTHER READING:

1. ЭИ N16 Diseases in the Elderly : Age-Related Changes and Pathophysiology, Nagaratnam, Nages. , Cheuk, Gary. , Nagaratnam, Kujan. , Cham: Springer International Publishing, 2016
2. ЭИ H99 Hypertension and Stroke : Pathophysiology and Management, , Cham: Springer International Publishing, 2016
3. ЭИ P32 Pathophysiology of Respiration : , , Cham: Springer International Publishing, 2016

4. ЭИ Т51 Thyroid and Heart Failure : From Pathophysiology to Clinics, , Milano: Springer Milan,, 2009

5. ЭИ Л64 Клиническая патофизиология : курс лекций, тесты, задачи = Clinical pathophysiology : concise lectures, tests, cases : тезисы докладов/сообщений научной конференции (съезда, симпозиума), , Москва: ГЭОТАР-Медиа, 2019

SOFTWARE:

No special softwares is required

LMS AND ONLINE RESOURCES

1. Pathophysiology (<https://online.mephi.ru>)

2. International Society of Pathophysiology (<https://ispweb.cc/>)

3. Pathophysiology - official journal of the International Society for Pathophysiology (<https://www.mdpi.com/journal/pathophysiology>)

<https://online.mephi.ru/>

<http://library.mephi.ru/>

9. LOGISTICAL SUPPORT

1. Аппарат для электрофизиологических исследований MP35 (Биорас Student Lab, полная комплектация для PC (64-306)

2. Персональный компьютер: Моноблок Lenovo V540-24IWL All-In-One 23,8" i3-8145U 8Gb 256GB_SSD_M.2 Intel (64-305)

3. Мышь, клавиатура (64-305)

4. Интерактивная доска SMART SBM 685 (64-305)

5. Проектор SMART P109 (64-305)

6. Мебель лабораторная, стулья, шкафы для хранения (64-305)

7. Мойка лабораторная (64-305)

8. Шкаф лабораторный вытяжной "Лабтех" ШВ202 (64-305)

10. EDUCATIONAL AND METHODOLOGICAL RECOMMENDATIONS FOR STUDENTS

The main task of higher education is to develop creative specialists who are capable of self-development, self-education, and innovative activity. It is hardly possible to achieve this task simply by transferring ready-made knowledge from the teacher to the student. It is necessary to transform students from passive consumers of knowledge into active creators of knowledge, capable of formulating problems, analyzing ways to solve them, finding optimal solutions, and proving their

correctness. In this regard, independent student work (ISW) is the fundamental form of the educational process.

An important condition for the acquisition of theoretical knowledge is taking lecture notes and mastering scientific terminology. Lecture course materials should be supplemented in a timely manner by studying the relevant sections in textbooks, teaching aids, scientific articles, monographs, and reference books. Additional study of the material is carried out in seminars, during which students analyze in detail the main components of the topic being studied. During a presentation or dialogue with the instructor, the content of the main topics of the course is reviewed and the latest publications on the issues being studied are discussed.

11. EDUCATIONAL AND METHODOLOGICAL RECOMMENDATIONS FOR TEACHERS

In the process of organizing and conducting the educational process, teachers must be able to plan and organize their time, which allows them to distribute the workload and is an important condition for successful teaching of the discipline.

Teachers should actively participate in the educational process and prepare for it. The need for constant preparation for lectures, seminars, and practical classes is due to the need to reflect modern approaches, views, and data on topics and sections. When preparing for the educational process, it is necessary to study modern methodological recommendations, the results of scientific research, new technologies, etc.

The goal of the teacher's work should be the effective perception of the material by the students. The following types of educational activities are implemented in the teaching process: lectures, seminars and practical classes, and independent work. When implementing various types of educational activities, the teacher should use educational technologies (creation of interactive presentations, educational computer programs, thinking development technologies (effective lectures, tables, group work, etc.)).

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