

SYLLABUS

1. General information on the course

Full course name	Pathophysiology
Full official name of a higher education institution	Sumy State University
Full name of a structural unit	Medical Institute. Physiology and Pathophysiology Department with Medical Biology Course
Author(s)	Ataman Oleksandr Vasylovych
Cycle/higher education level	The Second Level Of Higher Education, National Qualifications Framework Of Ukraine – The 7th Level, QF-LLL – The 7th Level, FQ-EHEA – The Second Cycle
Semester	18 weeks across 5 semester, 20 weeks across 6 semester
Workload	5 ECTS, 150 hours, out of which 94 hours are working hours with the lecturer (22 hours of lectures, 72 hours of seminars)
Language(s)	English

2. Place in the study programme

Relation to curriculum	Compulsory course available for study programme "Medicine"
Prerequisites	Knowledge of the basics of medical biology, histology, biochemistry, physiology, microbiology
Additional requirements	There are no specific requirements
Restrictions	There are no specific restrictions

3. Aims of the course

Formation of knowledge and practical skills in pathophysiology for further mastering of the block of disciplines providing professional and practical training of the future doctor

4. Contents

Module 1. General nosology

Topic 1 Common teaching about disease. General etiology and pathogenesis

Pathophysiology as a science. The place of pathophysiology in the system of medical knowledge. Pathophysiology as an academic discipline, its components: general pathology, pathophysiology of organs and systems. The place of pathophysiology in the system of doctor training. Methods of pathophysiology. History of pathophysiology development. Basic concepts of nosology: norm, health (WHO), disease, pathological process, typical pathological process, pathological reaction, pathological condition. Principles of disease classification, WHO classification. The main directions of the doctrine of the disease: humoral (Hippocrates), solidarity (Democritus), cellular (R. Vikhrov). Definition of "etiology". The main directions of development of the doctrine of etiology: monocausalism, conditionalism, constitutionalism, psycho-somatic concept, etc. Modern ideas about causality in pathology. Classification of etiological factors. Definition of "pathogenesis". Pathological (destructive) and adaptive-compensatory (protective) phenomena in pathogenesis. Manifestations of damage at different levels: molecular, cellular, tissue, organ, at the level of the organism as a whole. Protective adaptive reactions. Adaptation, compensation. Mechanisms of immediate and long-term adaptation. The role of nervous and humoral factors in their implementation.

Topic 2 Pathogenic effects of environmental factors

Pathogenic action of mechanical factors. Patterns of development of mechanical trauma, long-term crushing syndrome, traumatic illness. Pathogenic action of thermal factors. Protective, compensatory reactions and actual pathological changes in hyperthermia. Heat and sunstroke. Burns, burn disease. Hypothermia. Protective, compensatory reactions and actually pathological changes. Mechanisms of long-term adaptation to cold. Artificial hypothermia, its use in medicine. Local action of low temperatures: frostbite. Pathogenic effect of electric current. Factors that determine the nature of the lesions. Effect on the body of high and low atmospheric pressure. Causal relationships in the pathogenesis of compression and decompression syndromes. Explosive decompression. Influence on an organism of factors of space flight - acceleration, weightlessness. Pathogenic effect of radiant energy. Types of ionizing radiation. Radiosensitivity of tissues. Mechanisms of direct and indirect radiation damage of biological structures. Radiolysis of water. Radiotoxins. Manifestations of radiation damage at the molecular, cellular, tissue, organ and system levels. Pathogenesis of radiation sickness, its main forms and syndromes. Immediate and long-term effects of large and small doses of ionizing radiation. Stochastic and non-stochastic effects. Natural mechanisms of radiation protection. Pathophysiological bases of radioprotection.

Topic 3 The role of heredity, constitution, age factors in pathology

Heredity as a cause and condition of disease development. The ratio of hereditary and acquired in the pathogenesis. Classification of hereditary diseases. Mutations. Principles of their classification. Types of mutations. Causes of mutations. Monogenic hereditary diseases. Characteristics of monogenic diseases by type of inheritance of pathological gene. Polygenic (multifactorial) diseases. Hereditary predisposition to disease. Chromosomal diseases. Mechanisms of genome and chromosomal mutations. Methods of diagnosis, principles of prevention and treatment of hereditary diseases. Ways to correct genetic defects. Prospects for genetic engineering. Constitution, its role in pathology. Classification of constitutional types according to Hippocrates, Sigo, Sheldon, Kretschmer, Pavlov. The concept of antenatal pathology. Gameto-, blasto-, embryo- and fetopathy. Teratogenic factors. Aging. Factors determining species, individual and average life expectancy. General features and patterns of aging. Structural, functional and biochemical manifestations of aging at the molecular, cellular, tissue, organ, systemic levels and at the level of the organism as a whole. Theories of aging. Aging and disease. Progeria. Theoretical foundations of life expectancy. Methods of geroprotection.

Topic 4 Reactivity and resistance. Pathophysiology of immunological reactivity

Reactivity as a condition for the development of diseases. Manifestations of reactivity at the molecular, cellular, tissue, organ, systemic levels and at the level of the organism as a whole. Types of reactivity. Dependence of reactivity on sex, age, heredity, state of immune, nervous and endocrine systems. Influence of environmental factors on the reactivity of the organism. The concept of resistance. Passive and active resistance. Relationship between resistance and reactivity. Mechanisms of nonspecific resistance. Biological barriers, their classification, importance in the body's resistance. The role of the physiological system of connective tissue in the body's resistance to pathogenic effects. Humoral factors of nonspecific resistance of an organism to infectious agents. Complement system of agents (OO Bogomolets). Phagocytosis. Disorders of phagocytosis: causes, mechanisms, and its violation. Mechanisms of immune response of humoral and cellular type, mechanisms of immunological tolerance, its types and reproduction in experiment. General patterns of immune system disorders, hyper-, hypo- and dysfunction of the immune system. Experimental modeling of pathology of the immune system. Immune deficiency, definition, classification (WHO). Causes, mechanisms of development, types of primary immunodeficiencies. The role of physical, chemical and biological factors in the development of secondary immunodeficiency.

Topic 5 Allergy

Definition and general characteristics of allergies. Etiology of allergies, types of exogenous and endogenous allergens. Formation of allergic reactions depending on the state of the organism. The importance of hereditary and acquired factors in the development of allergies. Principles of classification of allergic reactions. Classification of allergic reactions according to Coombs and Jell. Stages of pathogenesis of allergic reactions. Anaphylactic reactions: experimental models, basic clinical forms. Cytotoxic reactions: experimental modeling, main clinical forms. Mechanisms of cytolysis: complement-dependent cytolysis, anti-body-dependent phagocytosis, antibody-dependent cellular cytotoxicity. The role of complement and its activation products in the development of cytotoxic reactions. Immunocomplex reactions: reproduction in the experiment, the main clinical forms. Factors determining the pathogenicity of immune complexes. Immunocomplex lesions, their local and general manifestations. Cellular reactions (delayed-type hypersensitivity reactions): experimental reproduction, basic clinical forms. Features of immunological mechanisms. The role of lymphokines. Allergic reactions of stimulating and inhibitory type, clinical forms. Autoallergic reactions. Causes and mechanisms of their development. The role of the autoallergic component in the pathogenesis of diseases. Basic principles of prevention and treatment of allergy.

Topic 6 Final class in module 1 "General nosology"

All topics of module 1.

Module 2. Typical pathological processes

Topic 7 Peripheral circulatory disorders

causes and mechanisms of development, external manifestations. The role of endothelial factors in the pathogenesis of local circulatory disorders. Tissue changes caused by local circulatory disorders, their significance and possible consequences. The concept of reperfusion syndrome, ischemic toxicosis. Thrombosis and embolism as causes of local circulatory disorders. Causes and conditions of thrombosis. Types of emboli, mechanisms of embolism. The role of reflex mechanisms in the development of general disorders caused by embolism. Features of the course of embolism of large and small circles of blood circulation, portal vein. Typical disorders of microcirculation. Intravascular disorders. Sludge syndrome. Disseminated intravascular coagulation syndrome. Capillary (true) stasis. Violation of the tone, mechanical integrity and permeability of microvessels. Extravascular disorders of microcirculation. Capillarotrophic insufficiency. Typical lymphatic disorders. Mechanical, dynamic and resorption insufficiency of lymphatic circulation.

Topic 8 Inflammation

Definition of inflammation. Classifications of inflammation. Etiology of inflammation. General and local manifestations of inflammation. Pathogenesis of acute inflammation. Stages of inflammation. Alteration (primary and secondary), causes and mechanisms of secondary alteration. Biochemical and physicochemical disorders in the inflammatory focus. Inflammation mediators, their classification. Plasma mediators (proteins of the acute phase, proteins of complement systems, coagulation / anti-coagulation, fibrinolysis, kinins). Mediators of cellular origin, specific and nonspecific. Cytokines: types, characteristics of action. Mediators from tissue basophils. Eicosanoids. Disorders of local blood circulation in the focus of acute inflammation. The experiment of J. Congheim. Pathogenesis of ischemia and arterial hyperemia. The reasons for the transition of arterial hyperemia to venous. Exudation at the site of acute inflammation, causes and mechanisms. Characteristics of exudates. Emigration of leukocytes in the inflammatory focus. Stages, causes and mechanisms of leukocyte emigration. Adhesive molecules of leukocytes and endotheliocytes. Causes and mechanisms of leukocyte chemotaxis. Mechanisms of microbial neutralization by leukocytes. Phagocytosis: stages, mechanisms of destruction of phagocytosis objects. Proliferation. Causes and mechanisms of proliferation. The role of reactivity. Principles of anti-inflammatory therapy.

Topic 9 Fever

Definition of the concept. General characteristics of fever, its formation in onto- and phylogeny. Etiology of fever. Characteristics of pyrogens. Primary and secondary pyrogens. Pyrogen formation during infection, aseptic injury and immune reactions. Chemical nature and origin of secondary ("real") pyrogens. Mechanisms of influence on the center of thermoregulation. Stages of fever. Principles of classification, types of fever. Involvement of nervous, endocrine and immune systems in the development of fever. Changes in metabolism and physiological functions in fever. Protective value and pathological manifestations of fever. Pathophysiological principles of antipyretic therapy. The concept of pyrotherapy. The main differences between fever, exogenous overheating and other types of hyperthermia.

Topic 10 Tumors

General patterns of tumor growth. Principles of tumor classification. Experimental study of etiology and pathogenesis of tumors. Etiology of tumors. Physical, chemical and biological carcinogenic factors. Physical carcinogenic factors. Chemical carcinogens, their classification. Exogenous and endogenous carcinogens. Chemical carcinogens of direct and indirect action. Features of the chemical structure of compounds that determine their carcinogenicity. Classification of oncogenic viruses. Viral carcinogenesis. Experimental evidence of viral origin of tumors. Pathogenesis of tumor growth. Stages of pathogenesis: initiation, promotion and progression. Mutational and epigenomic mechanisms of malignant transformation. Disorders of the system of genes that provide cell division. The concept of protooncogenes, oncogenes (cellular, viral), genes-suppressors of cell division. Methods of conversion of protooncogene to oncogene. The role of apoptosis in the pathogenesis of tumor growth. Mechanisms of tumor progression. Interaction of tumor and organism. The effect of the tumor on the body. Mechanisms of cancerous cachexia. Mechanisms of natural antitumor protection, immune and non-immune mechanisms of resistance. Mechanisms of tumor evasion from immune surveillance. Pathophysiological bases of tumor prevention and treatment.

Topic 11 Final class in module 2 "Typical pathological processes"

All topics of module 2.

Module 3. Typical metabolic disorders

Topic 12 Energy, lipid and protein metabolism disorders. Starvation

Disorders of digestion and absorption of lipids. Disorders of lipid transport in the blood. Hyper-, hypo-, dyslipoproteinemia. Etiology, pathogenesis of primary (hereditary, familial) and secondary dyslipoproteinemias. Definition of obesity. Types of obesity. Experimental models. Etiology and pathogenesis of obesity. Violation of the main stages of protein metabolism. Azotemia, productive and retention. Disorders of blood protein composition: hyper-, hypo-, dysproteinemia. Gout: etiology, pathogenesis. Hyper- and hypouricemia. Definition, types of starvation: physiological, pathological; complete, absolute, incomplete, partial. External and internal causes of starvation. Characteristics of disorders of basic metabolism and metabolism in certain periods of complete starvation with water. Pathophysiological features of incomplete starvation. Types, etiology, pathogenesis of partial (qualitative) starvation. Protein-calorie deficiency, its forms: alimentary insanity, kwashiorkor. Alimentary dystrophy.

Topic 13 Carbohydrate metabolism disorders. Diabetes

Disorders of carbohydrate absorption, processes of synthesis, deposition and breakdown of glycogen, transport of carbohydrates into cells. Disorders of nervous and hormonal regulation of carbohydrate metabolism. Hypoglycemia syndrome: types, causes, mechanisms. Pathogenesis of hypoglycemic coma. Hyperglycemia syndrome: types, causes and mechanisms of development. Diabetes. Definition, classification (by WHO). Experimental modeling of diabetes mellitus. Etiology, pathogenesis of type 1 diabetes mellitus. The role of hereditary and environmental factors in its origin and development. Pathogenesis of absolute insulin insufficiency, its manifestations and consequences: violation of energy, protein, carbohydrate, fat, water-electrolyte metabolism, acid-base state. Etiology, pathogenesis of type 2 diabetes. The role of hereditary and environmental factors in its origin and development. Variants of relative insulin insufficiency in type 2 diabetes (secretory disorders of B cells, resistance of target tissues to insulin). Manifestations and consequences of relative insulin insufficiency. The concept of metabolic syndrome. Complications of diabetes. Coma: varieties, causes and mechanisms of development, manifestations, principles of therapy. Long-term complications (macro-, microangiopathy, neuropathy, fetopathy, etc.), their general characteristics. Prevention of the occurrence and development of diabetes.

Topic 14 Water-salt metabolism disorders

Positive and negative water balance. Dehydration: extracellular and intracellular; hypo-, iso-, hyperosmolar. Causes and mechanisms of development. Protective and compensatory mechanisms. Excessive accumulation of water in the body. Hypo-, iso- and hyperosmolar hyperhydria, causes and mechanisms of development, protective, compensatory reactions. Extra- and intracellular hyperhydria. Definition of "edema", types of edema. Causes and mechanisms of edema. The theory of the pathogenesis of Starling's edema. Edema caused by changes in oncotic pressure of blood and tissue fluid. The role of vascular permeability disorders and lymph outflow in the pathogenesis of edema. Edema caused by retention of sodium and / or water salts in the body. Myxedematous edema. Principles of treatment of edema. Hyper- and hyponatremia. Causes and mechanisms of development. Disturbances caused by changes in the concentration of sodium ions in the extracellular fluid. Hyper- and hypokalemia. Causes and mechanisms of development. The main manifestations of disorders of potassium ion metabolism.

Topic 15 Calcium and phosphate metabolism disorders

Disorders of hormonal regulation of phosphorus-calcium metabolism: hyper- and hypoparathyroidism, hypo- and hypervitaminosis D, disorders of calcitonin secretion. Hypocalcemic conditions: causes, mechanisms of development, main manifestations. Rickets: causes and mechanisms of development, the main clinical manifestations. Principles of prevention and treatment of rickets. Forms of rickets resistant to vitamin D. The concept of osteodystrophy. Hypercalcemic conditions, causes and mechanisms of development. Calcification (calcification) of soft tissues: metastatic, dystrophic and metabolic mechanisms. Hyper- and hypo-phosphatemia. Causes and mechanisms of development.

Topic 16 Acid-base balance disorders

General characteristics of acid-base disorders (ACS). Acidosis, definition, classification, basic laboratory criteria. Gas acidosis: causes and mechanisms of development, clinical manifestations. Non-gas acidosis (metabolic, excretory, exogenous): causes and mechanisms of development, the relationship between CBS and electrolyte disorders. Acidosis with increased and normal anionic difference. Alkalosis, definition, classification, basic laboratory criteria. Gas alkalosis: causes and mechanisms of development, clinical manifestations. Non-gaseous alkalosis (excretory, exogenous): causes and mechanisms of development. The role of buffer systems of blood, ion exchange, respiratory system and kidneys in the mechanisms of compensation and correction of CBS disorders. Pathological changes in the body in disorders of acid-base status. Principles of pathogenic therapy of acidosis and alkalosis.

Topic 17 Final class in module 3 "Typical metabolic disorders"

All topics of module 3.

Module 4. Pathophysiology of the blood system

Topic 18 Pathology of red blood cells. Anemia

Changes in total blood volume. Blood loss: etiology, pathogenesis. Erythrocytosis. Anemia: definition, clinical and hematological manifestations, principles of classification. Pathological, degenerative and regenerative forms of erythrocytes. Etiology, pathogenesis, hematological characteristics of posthemorrhagic anemia (acute and chronic). Etiological classification (hereditary, acquired) of hemolytic anemia. Characteristics of causal factors of acquired hemolytic anemia. Hemolysis of erythrocytes, intravascular and intracellular, as mechanisms of hemolytic anemia. Classification of anemias associated with erythropoiesis disorders (deficient, dysregulatory, hypo-, aplastic, etc.), general characteristics of the causes and mechanisms of development. Etiology, pathogenesis, typical changes of peripheral blood in iron deficiency anemia. The concept of iron-refractory anemia. Anemia caused by vitamin B2 and / or folic acid deficiency. Causes and mechanisms of absolute and relative deficiency of vitamin B2 and folic acid. Addison-Birmer malignant anemia. Characteristics of general disorders in the body with a deficiency of vitamin B2 and / or folic acid. Hematological characteristics of vitamin B12-, folate deficiency anemia.

Topic 19 Leukocytosis, leukopenia

Leukocytosis, principles of classification. Causes and mechanisms of reactive and redistributive leukocytosis. Neutrophilic, eosinophilic, basophilic, lymphocytic and monocytic leukocytosis. The concept of nuclear shift of neutrophilic granulocytes, its varieties. Leukopenia, principles of classification. Causes, mechanisms of leukopenia, agranulocytosis (neutropenia). Pathogenesis of the main clinical manifestations. Acquired and hereditary disorders of the structure and function of leukocytes. Leukemoid reactions.

Topic 20 Leukemia

Representation of hemoblastosis, general characteristics of their main groups. Leukemia as a tumor. Principles of classification of leukemia (acute, chronic; myelo-, lympho-, biphenotypic; primary, secondary). Etiology of leukemia: characteristics of leukogenic factors of physical, chemical, biological nature. Mechanisms of their transforming action on hematopoietic cells of the bone marrow. Anomalies of genotype and constitution as risk factors for the occurrence and development of leukemia. "Peaks" of leukemia in children. Typical patterns and features of the pathogenesis of acute and chronic leukemias: disorders of the cellular composition of bone marrow and peripheral blood; morphological, cytogenetic, cytochemical, immunophenotypic characteristics; systemic disorders in the body. Progression of leukemia, the concept of "blast crisis". Leukemia metastasis. Principles of diagnosis and treatment of leukemia.

Topic 21 Disorders of hemostasis

General characteristics of typical disorders in the hemostasis system. Hemorrhagic disorders of hemostasis. Insufficiency of vascular and platelet hemostasis. Vasopathies: types, causes, mechanisms of development, pathogenesis of the main clinical manifestations. Thrombocytopenia: etiology, pathogenesis, mechanisms of hemostasis disorders. Thrombocytopathy. Mechanisms of adhesion disorders, platelet aggregation, release of platelet granules. Violation of coagulation hemostasis. The reasons for the decrease in the activity of the blood coagulation system and the increase in the activity of the anticoagulant and fibrinolytic systems. The main manifestations of disorders of certain stages of blood clotting, their etiology and pathogenesis. Thrombophilic conditions: thrombosis, disseminated intravascular coagulation (DIC), localized intravascular coagulation. Principles of classification of DIC syndrome (according to the course - acute, subacute, chronic; by the trigger mechanism of coagulation), etiology, pathogenesis. Role in pathology. Principles of correction of disorders in the hemostasis system.

Topic 22 Final class in module 4 "Pathophysiology of the blood system"

All topics of module 4.

Module 5. Pathophysiology of the cardiovascular system and external respiration

Topic 23 Pathophysiology of the heart. Heart failure. Arrhythmias

Definition of the concept of circulatory failure, principles of its classification, characteristics of cardio- and hemodynamic disorders. The concept of acute and chronic ("stagnant") circulatory failure. Etiology, pathogenesis, stages of chronic circulatory failure. Mechanisms of development of the main clinical manifestations of chronic circulatory failure (dyspnea, cyanosis, edema). Acute circulatory failure: etiology, pathogenesis, pathological and adaptive-compensatory changes. Collapse, shock as variants of acute circulatory failure. Definition of heart failure, principles of classification. Heart failure due to overload. Causes of heart overload and resistance. Mechanisms of immediate and long-term adaptation of the heart to overload: tachycardia, hyperfunction (hetero-, homeometric), myocardial hypertrophy. Cardiac hypertrophy: types, causes, mechanisms of development, stages (according to FZ Meerson). Features of hypertrophied myocardium, causes and mechanisms of its decompensation. Myocardial form of heart failure.

Topic 24 Coronary heart disease. Atherosclerosis. Hypertension

Coronary insufficiency (relative and absolute; acute and chronic), mechanisms of development. The concept of "critical stenosis". Consequences of myocardial ischemia. Ischemic heart disease as a manifestation of coronary insufficiency, its varieties. Clinical and laboratory criteria, manifestations and complications of myocardial infarction. Pathogenesis of cardiogenic shock. Cardiac arrhythmias: classification, causes, mechanisms, typical electrocardiographic manifestations. Atherosclerosis. Risk factors for atherosclerosis. Experimental models. Modern and historical theories of atherogenesis: the role of endothelial damage, inflammation, hereditary. Hypertension, definition, principles of classification. Hemodynamic variants of hypertension. The role of disorders of pressor and depressor systems in the development of hypertension. Primary and secondary arterial hypertension. Etiology, pathogenesis. Experimental models. Theories of the pathogenesis of primary hypertension. Arterial hypotension: definition, criteria. Etiology and pathogenesis of acute and chronic hypotension.

Topic 25 Pathophysiology of respiration

Definition of the concept of respiratory failure, criteria, principles of classification. Extrapulmonary and pulmonary disorders of alveolar ventilation: central, neuromuscular, thoracodiaphragmatic, decreased airway patency, elastic properties of lung tissue, the number of functioning alveoli. Mechanisms of alveolar ventilation disorders: dysregulatory, restrictive, obstructive. Causes and mechanisms of gas diffusion disorders in the lungs. Pulmonary circulatory disorders. Violation of general and regional ventilation-perfusion relations in the lungs. Changes in the gas composition of the blood and acid-base status in various types of respiratory failure, their importance for the body. Pathogenesis of the main clinical manifestations of respiratory failure. Shortness of breath: types, causes, mechanisms of origin and development. Asphyxia, causes and mechanisms of development. Violation of non-respiratory functions of the lungs, their impact on systemic hemodynamics and the hemostasis system. Pathological breathing. Types of periodic and terminal respiration.

Topic 26 Hypoxia

Definition, principles of classification of hypoxia. Mechanisms of hypoxia development: reduction of supply and disturbance of oxygen utilization by cells. Etiology of the main types of hypoxia: hypoxic, respiratory, circulatory, blood, tissue, mixed. Changes in the gas composition of arterial and venous blood in different types of hypoxia. Immediate and long-term mechanisms of adaptation and adaptation to hypoxia. Resistance to hypoxia. Factors that provide it. Mechanisms of hypoxic cell damage. Modern principles of oxygen therapy. Iso- and hyperbaric oxygenation. Toxic effect of oxygen. Hyperoxia and free radical reactions. Hyperoxia as a cause of hypoxia.

Topic 27 Final class in module 5 "Pathophysiology of the cardiovascular system and respiration"

All topics of module 5.

Module 6. Pathophysiology of digestion, liver, kidneys

Topic 28 Pathophysiology of digestion. Impaired digestion in the oral cavity and stomach. Peptic ulcer disease

General ideas about indigestion, principles of classification. Causes of indigestion (maldigestion). The role of alimentary and infectious agents, disorders of nervous and humoral regulation of the digestive system. Relationship between digestive disorders and metabolic and energy disorders in the body. Appetite disorders. Anorexia. Causes and mechanisms of digestive disorders in the oral cavity. Etiology, pathogenesis, experimental models of caries and periodontitis. Causes, mechanisms and consequences of salivation disorders. Impaired motor function of the esophagus. Etiology, pathogenesis of heartburn. Indigestion in the stomach. General characteristics of disorders of motor and secretory functions of the stomach. Pathological gastric secretion, types; causes and mechanisms of development. Etiology, pathogenesis of gastric and / or duodenal ulcers. The role of *Helicobacter pylori*. Understanding the etiology and pathogenesis of symptomatic gastric and / or duodenal ulcers.

Topic 29 Pathophysiology of digestion. Digestive disorders in the intestines. Acute pancreatitis
Indigestion in the intestines, etiology, pathogenesis. Digestive disorders associated with insufficient secretion of pancreatic juice. Etiology, pathogenesis, complications of acute and chronic pancreatitis. Pathogenesis of pancreatic shock. Intestinal dyskinesias. Causes, mechanisms and manifestations of constipation and diarrhea. Intestinal obstruction: types, etiology, pathogenesis. Disorders of intestinal barrier function: intestinal autointoxication, coli-sepsis, dysbacteriosis. Disorders of cavity and parietal digestion in the intestines. Malabsorption syndrome: definition, manifestations (diarrhea, weight loss, protein deficiency, hypovitaminosis), causes and mechanisms of development. Intestinal enzymopathy.

Topic 30 Pathophysiology of the liver

Liver failure: definition, principles of classification. Etiology, pathogenesis, experimental models of liver failure. Typical disorders of carbohydrate, protein, lipid, water-electrolyte metabolism, metabolism of trace elements, vitamins and hormones, dysfunction of functional systems of the body in liver failure. Insufficiency of antitoxic function of the liver, the mechanism of the main manifestations. Types, causes, pathogenesis of hepatic coma. The role of cerebrototoxic substances. Insufficient excretory function of the liver, the main manifestations. Definitions, criteria, types of jaundice, their causes and mechanisms. Comparative characteristics of pigment metabolism disorders in hemolytic, hepatic and mechanical jaundice; syndromes of cholemia and hypo-, acholia. Gallstone disease. Portal hypertension syndrome: etiology, pathogenesis, manifestations. Mechanisms of ascites, hepatolienal and hepato-renal syndromes.

Topic 31 Pathophysiology of the kidneys

Causes and mechanisms of circulatory disorders in the kidneys. Causes and mechanisms of tubular reabsorption and secretion disorders. Quantitative and qualitative changes in the composition of urine. Oliguria, anuria and polyuria. Water, osmotic and hypertensive diuresis. Hypo- and isostenuria. Pathological components of urine: proteinuria, cylindruria, glucosuria, aminoaciduria, hematuria, leukocyturia. The concept of selective and non-selective proteinuria and its mechanisms. Causes, manifestations and mechanisms of retention azotemia. Pathogenesis of renal edema. Acid-base disorders: renal azotemic acidosis, proximal and distal tubular acidosis. Pathogenesis and manifestations of renal osteodystrophy. Mechanisms of development of arterial hypertension, anemia, hemostasis disorders in renal lesions. Syndromes of acute and chronic renal failure: criteria, causes and mechanisms of development. Pathogenesis of uremic coma. Glomerulonephritis: definition, principles of classification. Experimental models, modern ideas about the etiology and pathogenesis of diffuse glomerulonephritis. Nephrotic syndrome, primary and secondary. Causes and mechanisms of kidney stones, urolithiasis.

Topic 32 Final class in module 6 “Pathophysiology of digestion, liver and kidneys”

All topics of module 6.

Module 7. Pathophysiology of the endocrine and nervous system

Topic 33 Pathophysiology of the endocrine system

General characteristics of violations of endocrine system. Disorders of direct and reverse regulatory links. Pathology of hypothalamic-pituitary system. Hypopituitarism and hyperpituitarism. Pathophysiology of neurohypophysis. Etiology, pathogenesis, clinical signs of diabetes insipidus. Pathology of adrenal glands. Adrenal cortex deficiency: classification, etiology, pathogenesis, clinical signs. Adrenal cortex hyperfunction: classification (primary, secondary), etiology, pathogenesis, clinical signs. Itsenko-Cushing, Conn, adrenogenital syndromes. Adrenal medulla disorders: classification, etiology, pathogenesis, clinical signs. Pathology of thyroid gland. Hypothyroidism: causes and development mechanisms, pathogenesis of main manifestations. Hyperthyroidism: causes and development mechanisms, pathogenesis of main manifestations. Goiter: classification (endemic, sporadic, nodular and diffuse toxic), its etiology and pathogenesis; functional changes of the gland. Disorders of parathyroid glands: classification, causes, development mechanisms, clinical and pathophysiological signs. Disorders of gonads: primary and secondary hyper- and hypogonadism. Etiology, pathogenesis, extragenital symptoms of genital disorders. The concept of stress as non-specific, stereotypical adaptation reaction of the body to extreme stimuli. Stages of general adaptation syndrome development. Mechanisms of long-term adaptation. The concept of stress.

Topic 34 Pathophysiology of the nervous system

General characteristics of nervous system pathology, principles of disorder classification. Sensory function disorders of nervous system. Brown-Sekar syndrome. Signs of damage of thalamic centers and sensory structures of the cerebral cortex. Pain. The concept of pain as a type of sensitivity. Principles of pain classification. Somatic pain. Visceral pain. Modern theories of pain etiology and pathogenesis. Antinoceptive natural mechanisms. Principles and methods of anesthesia. Motor nervous system disorders. Experimental simulation of motor disorders. Peripheral and central paralyzes and paresis: etiology, pathogenesis, main clinical signs. Spinal shock. Motor disorders of subcortical origin. Cerebellar disorders. Convulsions, its types. Disorders of neuromuscular transmission. Myasthenia gravis. Nervous trophy disorders. Neurodystrophic process. Pathological excitation and inhibition of the nervous centers. Neurosis. Neuron injury as one of the reasons of integrative CNS disorders. Acute and chronic disorders of cerebral circulation. Stroke. Edema and brain swelling, etiology and pathogenesis. Intracranial hypertension. Significance of the neuroglia injury to pathological processes development in the CNS. Brain-blood (hematoencephalic) barrier injury and autoimmune cerebral damage.

Topic 35 Final class in module 7 “Pathophysiology of endocrine and nervous systems”

All topics of modile 7.

Topic 36 Final testing "Step-1"

5. Intended learning outcomes of the course

After successful study of the course, the student will be able to:

LO1	Analyze the role of environmental and internal factors biological factors (age, heredity, constitution, reactivity) in the occurrence and development of typical pathological processes (disorders of local circulation, inflammation, tumors, fever, hypoxia, starvation) and most common diseases of the blood and circulatory system, external respiration, digestion, liver and kidney, endocrine and nervous systems
-----	---

6. Role of the course in the achievement of programme learning outcomes

Programme learning outcomes achieved by the course.

For 222 Medicine:

PO1	To detect and identify the leading clinical symptoms and syndromes (according to the List 1); to establish the most probable nosological or syndromic preliminary clinical diagnosis of diseases (according to the List 2) using standard methods, preliminary data of the patient's anamnesis, patient's examination data, and knowledge about a human, his organs and systems.
PO2	To collect information about the patient's general condition; to assess the patient's psychomotor and physical development and the state of organs and systems of the body; to assess information on the diagnosis (according to the List 4) based on laboratory and instrumental findings.

PO3	To order and analyze additional (mandatory and optional) examinations (laboratory, radiological, functional and/or instrumental) (according to the List 4) in order to perform a differential diagnosis of diseases (according to the List 2).
PO4	To establish a final clinical diagnosis at a medical institution under control of a supervising doctor by means of informed decision and logical analysis of the obtained subjective and objective data of clinical and additional examinations, and differential diagnosis, following the relevant ethical and legal norms (according to the List 2).
PO5	To detect the key clinical syndrome or the reason for patient's condition severity (according to the List 3) via informed decision and evaluation of the person's state under any circumstances (at home, in the street, at a healthcare facility), including under emergency and military operation conditions, in the field, with a lack of information and limited time.
PO19	To assess environmental impact on public health.

7. Teaching and learning activities

7.1 Types of training

Topic 1. Common teaching about disease. General etiology and pathogenesis	
lect.1 "Common teaching about disease. General etiology and pathogenesis" (full-time course)	The subject and methods of pathophysiology. Etiology. Pathogenesis. Multimedia interactive lecture with elements of problematycity In conditions of quarantine restrictions is carried out on line on Google Meet.
pr.tr.1 "Common teaching about disease. General etiology and pathogenesis" (full-time course)	The doctrine of the disease, general etiology and pathogenesis. Analysis of actually pathological and protective physiological changes in the body using the example of acute blood loss. Pathophysiological interpretation of clinical manifestations of blood loss.
Topic 2. Pathogenic effects of environmental factors	
pr.tr.2 "Pathogenic effects of environmental factors" (full-time course)	Патогенна дія термічних факторів і радіації на організм. Постановка віртуальних експериментів на тваринах з аналізом їх результатів.
Topic 3. The role of heredity, constitution, age factors in pathology	
pr.tr.3 "The role of heredity, constitution, age factors in pathology" (full-time course)	Classification of hereditary diseases. Monogenic and chromosomal diseases. Analysis of pedigrees and the likelihood of hereditary pathology in specific clinical cases.
Topic 4. Reactivity and resistance. Pathophysiology of immunological reactivity	
pr.tr.4 "Reactivity and resistance. Pathophysiology of immunological reactivity" (full-time course)	Violation of nonspecific and specific humoral and cellular mechanisms of immunity. Pathophysiological analysis of specific clinical cases with discussion of the results such analysis

Topic 5. Allergy
lect.2 "Allergy" (full-time course) Allergy. Etiology and pathogenesis. The subject and methods of pathophysiology. Etiology. Pathogenesis. Multimedia interactive lecture on the elements of problemat�icity. In quarantine conditions restrictions are made on line by Google Meet.
pr.tr.5 "Allergy" (full-time course) Allergic reactions according to the classification of Coombs and Jella. Stages of allergy pathogenesis. Pathophysiological analysis of specific clinical cases with discussion of the results such analysis
Topic 6. Final class in module 1 "General nosology"
pr.tr.6 "Final class in module 1 "General nosology"" (full-time course) Classes are conducted by final testing and a survey on the topics covered in the module.
Topic 7. Peripheral circulatory disorders
pr.tr.7 "Peripheral circulatory disorders" (full-time course) Local circulation disorders: arterial and venous hyperemia, ischemia, stasis, thrombosis, embolism. Conducting a virtual experiment with the analysis of its results.
Topic 8. Inflammation
lect.3 "Inflammation" (full-time course) Inflammation. General characteristics. Etiology. Pathogenesis. A multimedia interactive lecture with elements of problemat�icity. Under the conditions of quarantine restrictions, it is produced on line at Google Meet.
pr.tr.8 "Inflammation" (full-time course) Etiology and pathogenesis of inflammation. Stages of the inflammatory process. Conducting a virtual experiment with analysis of its results
Topic 9. Fever
pr.tr.9 "Fever" (full-time course) Etiology and pathogenesis of fever. Analysis of different types of temperature curves. Conducting a virtual experiment with analysis of its results
Topic 10. Tumors
lect.4 "Topic 10. Tumors" (full-time course) Tumor process. General characteristics. Chemical and radiation carcinogenesis. Multimedia interactive a lecture with elements of problematic nature. Under the conditions of quarantine restrictions, it is conducted on line at Google Meet.

<p>pr.tr.10 "Tumors" (full-time course)</p> <p>Etiology and pathogenesis of a malignant tumor process. Discussion of modern concepts of chemical and viral oncogenesis.</p>
<p>Topic 11. Final class in module 2 "Typical pathological processes"</p>
<p>pr.tr.11 "Final class in module 2 "Typical pathological processes"" (full-time course)</p> <p>The lesson is conducted by final testing and a survey on the topics covered by the module.</p>
<p>Topic 12. Energy, lipid and protein metabolism disorders. Starvation</p>
<p>pr.tr.12 "Energy, lipid and protein metabolism disorders. Starvation" (full-time course)</p> <p>Fasting classification. Obesity. Hereditary disorders of amino acid metabolism. Gout. Pathophysiological analysis of specific clinical cases with discussion of the results such analysis</p>
<p>Topic 13. Carbohydrate metabolism disorders. Diabetes</p>
<p>lect.5 "Carbohydrate metabolism disorders. Diabetes" (full-time course)</p> <p>Typical disorders of carbohydrate metabolism. Diabetes mellitus, etiology, pathogenesis. Multimedia interactive lecture on the elements of problematicity. Under quarantine restrictions, it is done online at Google Meet.</p>
<p>pr.tr.13 "Carbohydrate metabolism disorders. Diabetes" (full-time course)</p> <p>Diabetes mellitus type 1 and 2: etiology and pathogenesis. Pathophysiological analysis of specific clinical cases with discussion of the analysis results.</p>
<p>Topic 14. Water-salt metabolism disorders</p>
<p>lect.6 "Water-salt metabolism disorders" (full-time course)</p> <p>Typical disorders of water-salt metabolism. Hyper- and hypohydria. Swelling. Multimedia interactive lecture with elements of problematicness In conditions of quarantine restrictions it is made on line at Google Meet.</p>
<p>pr.tr.14 "Water-salt metabolism disorders" (full-time course)</p> <p>Hyper- and hypohydria. Edema, their mechanisms. Pathophysiological analysis of specific clinical cases with discussion of the results of such analysis.</p>
<p>Topic 15. Calcium and phosphate metabolism disorders</p>
<p>pr.tr.15 "Calcium and phosphate metabolism disorders" (full-time course)</p> <p>Hyper- and hypocalcemia. Rickets: etiology and pathogenesis. Pathophysiological analysis of specific clinical cases with discussion of the results of such analysis.</p>
<p>Topic 16. Acid-base balance disorders</p>

<p>lect.7 "Acid-base balance disorders" (full-time course)</p> <p>Disturbances of acid-base balance. Acidosis and alkalosis. Multimedia interactive lecture with elements problems. In the conditions of quarantine restrictions it is carried out on line on Google Meet.</p>
<p>pr.tr.16 "Acid-base balance disorders" (full-time course)</p> <p>Causes and mechanisms of acidosis and alkalosis. Pathophysiological analysis of specific clinical cases with discussion of the results of such analysis.</p>
<p>Topic 17. Final class in module 3 "Typical metabolic disorders"</p>
<p>pr.tr.17 "Final class in module 3 "Typical metabolic disorders"" (full-time course)</p> <p>The lesson is conducted by final testing and survey on the topics of the module.</p>
<p>Topic 18. Pathology of red blood cells. Anemia</p>
<p>lect.8 "Pathology of red blood cells. Anemia" (full-time course)</p> <p>Anemia. General characteristics. Etiology and pathogenesis of anemia. Multimedia interactive lecture with elements of problem. Under conditions of quarantine restrictions to be conducted online on Google Meet.</p>
<p>pr.tr.18 "Pathology of red blood cells. Anemia" (full-time course)</p> <p>Etiology and pathogenesis of various forms of anemia. Pathophysiological analysis of specific clinical cases with discussion of the results of such analysis.</p>
<p>Topic 19. Leukocytosis, leukopenia</p>
<p>pr.tr.19 "Leukocytosis, leukopenia" (full-time course)</p> <p>Causes, mechanisms of leukocytosis and leukopenia. Pathophysiological analysis specific clinical cases with discussion of the results of such analysis.</p>
<p>Topic 20. Leukemia</p>
<p>pr.tr.20 "Leukemia" (full-time course)</p> <p>Etiology and pathogenesis of leukemia. Pathophysiological analysis of specific clinical cases with discussing the results of such an analysis.</p>
<p>Topic 21. Disorders of hemostasis</p>
<p>pr.tr.21 "Disorders of hemostasis" (full-time course)</p> <p>Hemorrhagic syndrome, its causes and mechanisms. DIC syndrome. Pathophysiological analysis of specific clinical cases with discussion of the results of such analysis.</p>
<p>Topic 22. Final class in module 4 "Pathophysiology of the blood system"</p>
<p>pr.tr.22 "Final class in module 4 "Pathophysiology of the blood system"" (full-time course)</p> <p>Classes are held by final testing and questionnaires module topics.</p>
<p>Topic 23. Pathophysiology of the heart. Heart failure. Arrhythmias</p>

<p>pr.tr.23 "Pathophysiology of the heart. Heart failure. Arrhythmias" (full-time course) Options for heart failure. Causes and mechanisms of arrhythmias. Pathophysiological analysis of specific clinical cases with discussion of the results of such analysis.</p>
<p>Topic 24. Coronary heart disease. Atherosclerosis. Hypertension</p>
<p>lect.9 "Coronary heart disease. Atherosclerosis. Hypertension" (full-time course) Atherosclerosis. Modern ideas about the causes and mechanisms of development. Pathogenesis. Multimedia interactive lecture with elements of problem. In quarantine conditions restrictions are held online on Google Meet.</p>
<p>pr.tr.24 "Coronary heart disease. Atherosclerosis. Hypertension" (full-time course) Etiology and pathogenesis of coronary heart disease, atherosclerosis, hypertension.</p>
<p>Topic 25. Pathophysiology of respiration</p>
<p>pr.tr.25 "Pathophysiology of respiration" (full-time course) Insufficiency of external respiration, its pathogenetic variants. Pathophysiological analysis of specific clinical cases with discussion of the results of such analysis.</p>
<p>Topic 26. Hypoxia</p>
<p>pr.tr.26 "Hypoxia" (full-time course) Causes, mechanisms and consequences of oxygen starvation. Pathophysiological analysis of specific clinical cases with discussion of the results of such analysis.</p>
<p>Topic 27. Final class in module 5 “Pathophysiology of the cardiovascular system and respiration”</p>
<p>pr.tr.27 "Final class in module 5 “Pathophysiology of the cardiovascular system and respiration”" (full-time course) The lesson is conducted by final testing and survey on the topics of the module.</p>
<p>Topic 28. Pathophysiology of digestion. Impaired digestion in the oral cavity and stomach. Peptic ulcer disease</p>
<p>lect.10 "Pathophysiology of digestion. Impaired digestion in the oral cavity and stomach. Peptic ulcer disease" (full-time course) Etiology and pathogenesis of the most common diseases of the digestive system. Peptic ulcer disease, acute pancreatitis. Multimedia interactive lecture with elements of problem. In the conditions of quarantine restrictions it is carried out on line on Google Meet.</p>
<p>pr.tr.28 "Pathophysiology of digestion. Impaired digestion in the oral cavity and stomach. Peptic ulcer disease" (full-time course) Etiology and pathogenesis of caries and periodontitis. Gastric ulcers, mechanisms of their formation. Gastric or peptic ulcer: etiology and pathogenesis. Pathophysiological analysis of specific clinical cases with discussion of the results of such analysis.</p>
<p>Topic 29. Pathophysiology of digestion. Digestive disorders in the intestines. Acute pancreatitis</p>

<p>pr.tr.29 "Pathophysiology of digestion. Digestive disorders in the intestines. Acute pancreatitis" (full-time course)</p> <p>Etiology and pathogenesis of acute pancreatitis, intestinal obstruction. Pathophysiological analysis of specific clinical cases with discussion of the results of such analysis.</p>
<p>Topic 30. Pathophysiology of the liver</p>
<p>pr.tr.30 "Pathophysiology of the liver" (full-time course)</p> <p>Liver failure, its variants. Hepatic coma. Jaundice. Pathophysiological analysis of specific clinical cases with discussion of the results of such analysis.</p>
<p>Topic 31. Pathophysiology of the kidneys</p>
<p>lect.11 "Pathophysiology of the kidneys" (full-time course)</p> <p>Etiology and pathogenesis of acute and chronic renal failure. The main renal syndromes, their pathogenesis. Multimedia interactive lecture with elements of problem. In the conditions of quarantine restrictions it is carried out on line on Google Meet.</p>
<p>pr.tr.31 "Pathophysiology of the kidneys" (full-time course)</p> <p>Acute and chronic renal failure: etiology, pathogenesis. Pathophysiological analysis of specific clinical cases with discussion of the results of such analysis.</p>
<p>Topic 32. Final class in module 6 “Pathophysiology of digestion, liver and kidneys”</p>
<p>pr.tr.32 "Final class in module 6 “Pathophysiology of digestion, liver and kidneys”" (full-time course)</p> <p>The lesson is conducted by final testing and survey on the topics of the module.</p>
<p>Topic 33. Pathophysiology of the endocrine system</p>
<p>pr.tr.33 "Pathophysiology of the endocrine system" (full-time course)</p> <p>Hyper- and hypofunction of various endocrine glands: causes and mechanisms of development. Pathophysiological analysis of specific clinical cases with discussion of the results of such analysis.</p>
<p>Topic 34. Pathophysiology of the nervous system</p>
<p>pr.tr.34 "Pathophysiology of the nervous system" (full-time course)</p> <p>Causes and mechanisms of disorders of electrophysiological and neurochemical processes in the central nervous system. Pathophysiological analysis of specific clinical cases with discussing the results of such an analysis.</p>
<p>Topic 35. Final class in module 7 “Pathophysiology of endocrine and nervous systems”</p>
<p>pr.tr.35 "Final class in module 7 “Pathophysiology of endocrine and nervous systems”" (full-time course)</p> <p>The lesson is conducted by final testing and survey on the topics of the module.</p>
<p>Topic 36. Final testing "Step-1"</p>

pr.tr.36 "Final testing "Step-1"" (full-time course)
Testing on modules №1-7.

7.2 Learning activities

LA1	Performing practical tasks
LA2	E-learning using Zoom, Google Meet, MIX-SSU systems
LA3	Preparing for Step-1
LA4	Preparation for current and final control
LA5	Preparation for practical training
LA6	Working with textbooks and relevant information sources
LA7	Case discussion
LA8	Solving situational tasks
LA9	Self-study
LA10	Interpretation of laboratory (clinical analysis of blood, urine, biochemical analysis blood, immunological studies, etc.) and instrumental examination methods

8. Teaching methods

Course involves learning through:

TM1	Interactive lectures
TM2	Case-based learning (CBL)
TM3	Team-based learning (TBL)
TM4	Research-based learning (RBL)
TM5	Brainstorm
TM6	Study discussion

The teaching uses modern teaching methods such as CBL, TBL, RBL. They should contribute to the development of professional abilities and stimulate creative and scientific activities.

GC 1. Ability to abstract thinking, analysis, and synthesis. GC 2. Ability to learn, master modern knowledge, and apply the knowledge in practice. GC 3. Knowledge and understanding of the subject area and professional activity comprehension.

9. Methods and criteria for assessment

9.1. Assessment criteria

ECTS	Definition	National scale	Rating scale
	Outstanding performance without errors	5 (Excellent)	$170 \leq RD \leq 200$
	Above the average standard but with minor errors	4 (Good)	$140 \leq RD < 169$

	Fair but with significant shortcomings	3 (Satisfactory)	$120 \leq RD < 139$
	Fail – some more work required before the credit can be awarded	2 (Fail)	$0 \leq RD < 119$

9.2 Formative assessment

FA1	Self-assessment of ongoing testing
FA2	Teacher guidance in the process of completing practical tasks
FA3	Teacher's survey and oral comments of the results
FA4	Verifying experiment results
FA5	Checking and evaluating written tasks
FA6	Solving situational tasks
FA7	Solving situational tasks of Step-1

9.3 Summative assessment

SA1	Evaluation of written works, survey, solution and implementation of practical tasks
SA2	Testing
SA3	Final control: exam (in accordance with the regulations)

Form of assessment:

6 semester	200 scores
SA1. Evaluation of written works, survey, solution and implementation of practical tasks	100
	100
SA2. Testing	20
	20
SA3. Final control: exam (in accordance with the regulations)	80
	80

Form of assessment (special cases):

6 semester	200 scores
SA1. Evaluation of written works, survey, solution and implementation of practical tasks	100
In case of quarantine restrictions, practical exercises produced remotely using platforms Mix.sumdu.edu.ua, Zoom, Google meet.	100
SA2. Testing	20
In case of quarantine restrictions, practical exercises produced remotely using platforms Mix.sumdu.edu.ua, Zoom, Google meet.	20

SA3. Final control: exam (in accordance with the regulations)		80
	In case of quarantine restrictions, practical exercises produced remotely using platforms Mix.sumdu.edu.ua, Zoom, Google meet.	80

For each module (1, 2, 3, 4, 5, 6 + 7), a student can receive a maximum of 20 points, of which 5 points - oral questioning, 5 points - written work, 5 points - testing, 5 points - execution practical tasks. The points for the module are given as the sum of the arithmetic mean current classes, in which each of the components is separately assessed according to the traditional 4-point system. The maximum number of points that a student can receive in practical classes during the academic year - 120. The exam is held in accordance with the schedule at the end semesters during the examination session Examination tickets contain three theoretical questions on different topics and cover all sections of the academic discipline (20 points each), one practical task (20 points). The exam is credited to the student if he scored not less than 48 points out of 80. Commendation points are attached to the assessment of the discipline for the performance individual research project (defense of student scientific work 12 points, presentation at the conference 5 points, poster presentation at the conference 4 points, abstracts 3 points). The total score for the discipline cannot exceed 200 points.

10. Learning resources

10.1 Material and technical support

MTS1	Information and communication systems
MTS2	Library funds
MTS3	Computers, computer systems and networks
MTS4	Laboratory equipment (light microscopes "Biolam", blood products)
MTS5	Multimedia, video and sound reproducing, projection equipment (video cameras, projectors, screens, smartboards, etc.)
MTS6	Software (to support distance learning, web survey, virtual labs, virtual patients, computer graphics, simulations, etc.)
MTS7	Projection equipment

10.2 Information and methodical support

Essential Reading	
1	Robbins Basic Pathology. 10th Edition. Editors: Vinay Kumar Abul Abbas Jon Aster.- Elsevier, 2017.- 952p.
2	Pathophysiology: textbook / N. V. Krishtal, V. A. Mikhnev, N. N. Zayko etc. ; edited by N.V. Krishtal, V.A. Mikhnev. — K. : AUS Medicine Publishing, 2017. — 656 p.
Supplemental Reading	
3	Ataman, O. Crash Course in Pathophysiology. Questions & Answers / O. Ataman. — Vinnytsia : Nova knyha, 2019. — 520 p.

4	General and clinical pathophysiology = Загальна та клінічна патофізіологія : [textbook] / A. V. Kubyshkin, A. I. Gozhenko, V. F. Sagach et al. ; edited by A. V. Kubyshkin, A. I. Gozhenko. — 3rd ed. — Vinnytsia : Nova Knyha, 2019. — 656 p.
5	Porth, C.M. Pathophysiology: concepts of altered health states / C. M. Porth. — Lippincott Williams & Wilkins, 2016. — 1582 p.