

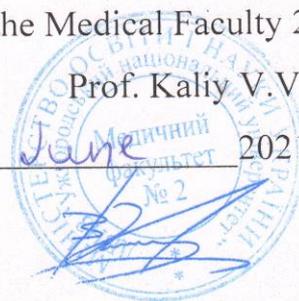
MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE  
STATE UNIVERSITY  
“UZHHOROD NATIONAL UNIVERSITY”  
MEDICAL FACULTY № 2  
DEPARTMENT OF FUNDAMENTAL MEDICAL DISCIPLINES

“APPROVED”

Dean of the Medical Faculty 2

Prof. Kaliy V.V.

“29” June 2021



**THE WORKING PROGRAM OF THE EDUCATIONAL DISCIPLINE  
PATHOPHYSIOLOGY**

Educational degree **Master**  
Studying direction **22 “Health Care”**  
Specialty **222 “Medicine”**  
Educational program **General medicine**  
Discipline status **Required**  
The language of instruction **English**

Uzhhorod 2021

Program in "Pathological Physiology" for international students for teaching in English in the studying direction 22 "Health Care", speciality 222 "Medicine"

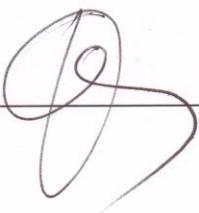
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Work Program is approved at the meeting of the

Department of Fundamental Medical Disciplines

Protocol № 7 from "18" June 2021

Head of the Department

of Fundamental Medical Disciplines  prof. Feketa V. P.

Approved by the Scientific and Methodological Commission of the Medical faculty №2

Protocol № 6 from "29" June 2021

Head of the Scientific and Methodological Commission  Malets N.B

## 1. Description of the Discipline

Name of indicators	Distribution of hours according to the curriculum	
	Full-time education	
Number of credits ECTS – 7	Year of studying:	
Total number of hours – 210	<b>3rd</b>	
Modules – 2	Term:	
Weekly hours for the full-time study:  classroom hours – 3 individual work – 5	<b>5th</b>	<b>6th</b>
	Lectures:	
	<b>20 hours</b>	<b>20 hours</b>
	Practical classes:	
	<b>30 hours</b>	<b>40 hours</b>
Type of final control: exam	Laboratory classes:	
Form of final control: written	Individual work:	
	<b>40 hours</b>	<b>60 hours</b>

## 2. THE AIM OF THE EDUCATIONAL DISCIPLINE

The purpose of the study course "Pathological physiology" is to develop students' ability to interpret the basic concepts of general nosology, to understand the causes, mechanisms of development and manifestations of typical pathological processes and most common diseases, to analyze, to draw conclusions about the causes and mechanisms of functional, metabolic and structural disorders body systems in diseases; provide basic training and practical skills for the next professional activity of a physician.

According to the educational program, the study of discipline promotes the formation of the following competences in the applicants for higher education:

GC 1. Ability to think abstractly, analyze and synthesize.

GC 2. The ability to learn and master modern knowledge.

GC 3. Ability to apply knowledge in practical situations.

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

GC 5. The ability to adapt and act in a new situation.

GC 6. Ability to make informed decisions.

GC 11. Information and communication technology usage skills.

GC 12. Definition and persistence of tasks and responsibilities.

GC 15. Ability to act on the basis of ethical considerations (motives).

PC 2. Patient information acquisition skills

PC 3. The ability to evaluate the results of laboratory and instrumental studies.

PC 6. Ability to conduct evacuation activities.

PC 14. Ability to plan preventive and anti-epidemic measures for infectious diseases.

PC 18. Ability to maintain medical records.

## 3. PREREQUISITES FOR STUDY DISCIPLINE

Prerequisites for studying the discipline "Pathological Physiology" are mastering the following educational disciplines (ED) of the educational program (EP):

Code 19 OK for EP "Physiology".

## 4. EXPECTED LEARNING RESULTS

In accordance with the educational program "Pathological Physiology", the study of educational discipline should ensure the achievement of applicants for higher education the following program results of study (PRS):

<b>Program results of study</b>	<b>Code of PRS</b>
Evaluate diagnosis information using standard procedures based on laboratory and instrumental findings.	PRS 2
To identify the leading clinical symptom or syndrome. To establish the most probable or syndromic diagnosis of the disease. To appoint laboratory and / or instrumental examination of the patient. To make differential diagnosis of diseases. To establish a preliminary and clinical diagnosis.	PRS 3
To determine the presence and degree of limitations of life, type, degree and duration of disability with the registration of relevant documents.	PRS 15

Expected learning outcomes that must be achieved by the recipients of education after mastering the course "Pathological Physiology":

<b>Code of ELO</b>	<b>Expected learning outcomes of the discipline</b>	<b>Code of PRS</b>
ELO 1	Ability to evaluate on the basis of laboratory data disorders from the blood system (anemia, leukocytosis, leukopenia, leukemia, hemostatic system disorders)	PRS 2
ELO 2	Ability to detect major disorders of the cardiovascular system according to the ECG	PRS 2
ELO 3	Ability to evaluate major abnormalities of respiratory function according to spirometry.	PRS 2
ELO 4	Ability to identify the pathology of the gastrointestinal tract, liver and kidney on the basis of data from general urine analysis and biochemical research.	PRS 2
ELO 5	Ability to identify the main causes and mechanisms of development of typical pathological processes (inflammation, fever, hypoxia, allergy, peripheral circulation disorders, tumors).	PRS 3
ELO 6	The ability to evaluate metabolic disorders, as well as quantitative and qualitative changes in the cells of the blood system.	PRS 3
ELO 7	Ability to interpret the causes, mechanisms of development and manifestations of the most common diseases (anemia, leukemia, atherosclerosis, coronary heart disease, bronchial asthma, hypertension, cirrhosis, gastric ulcer, nephritis, renal failure).	PRS 3
ELO 8	Ability to identify causes and mechanisms of regulatory system (endocrine and nerve) disorders.	PRS 3
ELO 9	The ability to determine the presence and degree of functional failure of body systems (cardiovascular, respiratory, hepatic, renal failure).	PRS 15

## **5. DIAGNOSTICS AND ASSESSMENT CRITERIA OF LEARNING RESULTS**

### **Assessment tools and methods for demonstrating learning outcomes**

Means of assessment and methods of demonstrating the results of training in the discipline are:

ELO 1. - test tasks, theoretical questions, situational task (medical history, general blood test).

ELO 2. - test tasks, theoretical questions, diagnosis and characterization of major heart rhythm disorders according to ECG data.

ELO 3. - test tasks, theoretical questions, diagnostics and characterization of major abnormalities of respiratory function according to spirometry.

ELO 4. - test tasks, theoretical questions, situational problem (medical history, general urine analysis, biochemical analysis).

ELO 5. - test tasks, theoretical questions, laboratory modeling of typical pathological processes by conducting an acute experiment.

ELO 6. - test tasks, theoretical questions, laboratory methods of research (glucosimetry, biochemical analysis of blood, evaluation of morphological picture of blood).

ELO 7. - test tasks, theoretical questions, identification and interpretation of the cause and mechanisms of development of leading clinical symptoms and syndromes of the most common diseases.

ELO 8. - test tasks, theoretical questions, interpretation of clinical situational problems.

ELO 9. - test tasks, theoretical questions, instrumental and laboratory methods of research.

## Forms of control and evaluation criteria for learning outcomes

Forms of current control: test tasks, individual oral questioning, practical work, tasks for independent work and solving typical situational problems.

Form of unit control: computer testing, written test work.

Form of semester control: final control (exam).

### Distribution of points received by higher education applicants (module 1)

Distribution of points received by higher education applicants (module 1)

<b>Ongoing assessment and selfstudy work</b>															
T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	Module 1	Total
8	8	8	8	10	8	8	8	8	10	8	8	8	12	80	200

T1. Subject, tasks and methods of pathophysiology.

T2. Pathogenic effect of external factors on the human body.

T3. The role of heredity, constitution and age-related changes in pathology.

T4. Immune reactivity disorders. Allergy.

T5. Submodule 1.

T6. Cell damage. Local circulatory disorders.

T7. Inflammation.

T8. Fever. Tumors.

T9. Starvation. Hypoxia.

T10. Submodule 2.

T11. Disorders of energetic and carbohydrate metabolism.

T12. Disorders of fat and protein metabolism.

T13. Disorders of water-electrolytic metabolism. Disorders of acid-base balance.

T14. Submodule 3.

T15. Final Module Control 1.

### Distribution of points received by higher education applicants (module 2)

Distribution of points received by higher education applicants (module 2)

<b>Ongoing assessment and selfstudy work</b>																
T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17
5	5	5	5	5	5	13	5	5	5	5	13	5	5	5	5	5

<b>Ongoing assessment and selfstudy work</b>														Module 2	Total
T18	T19													80	200
5	14														

- T1. Pathophysiology of the blood system. Changes in total blood volume. Erythrocytosis.
- T2. Pathophysiology of the blood system. Anemia.
- T3. Morphological picture of blood at different types of anemia.
- T4. Leukocytosis, leukopenia.
- T5. Leukemia.
- T6. Disorders of the hemostasis system.
- T7. Submodule 4.
- T8. Pathophysiology of external respiration. Respiratory failure.
- T9. Pathophysiology of the circulatory system. Circulatory insufficiency. Pathophysiology of the heart. Heart failure.
- T10. Pathophysiology of blood vessels.
- T11. Pathophysiological bases of heart rhythm disorders. Basics of ECG diagnosis.
- T12. Submodule 5.
- T13. Pathophysiology of the digestive system. Insufficiency of digestion.
- T14. Pathophysiology of the liver. Hepatic insufficiency.
- T15. Pathophysiology of the kidneys.
- T16. Pathophysiology of the endocrine system. General characteristics of disorders of the hypothalamus, pituitary, thyroid gland.
- T17. Pathophysiology of endocrine disorders in pathology of the adrenal glands and sex glands.
- T18. Pathophysiology of extreme conditions and nervous system.
- T19. Submodule 6
- T20. Final Module Control 2.

**Assessment of individual types of educational work in the discipline**

<b>Type of activity of higher education applicant</b>	<b>Module 1</b>		<b>Module 2</b>	
	Amount	Maximal score (total)	Amount	Maximal score (total)
Clinical (practical) classes	11	88	16	80
Computer-based testing for thematic evaluation	3	16	3	20
Written testing for thematic evaluation		16		20
Module Control	1	80	1	80
<b>Total</b>	<b>15</b>	<b>200</b>	<b>20</b>	<b>200</b>

**Evaluation criteria for modular control work**

Assessment for the final module control is defined as the sum of the assessments of the current educational activity (in points) and the assessment of the total of the module control (in points), which is presented when assessing theoretical knowledge and practical skills according to the lists determined by the discipline program.

The maximum number of points awarded to students in mastering each module is 200, including 120 points for the current academic activity, and 80 points for the results of the module final control.

Ongoing control is carried out at each practical session according to the specific objectives of each topic.

**Assessment of current educational activities:**

The weight of each topic within the same module should be the same, but may be different for different modules of the same discipline and is determined by the number of topics in the module.

**Module 1**

Ongoing assessment and selfstudy work			Final Module Control	Total
Submodule 1	Submodule 2	Submodule 3		
T 1 - T4 - 8 points, <b>T5 – 10 points</b>	T 6 - T9 - 8 points, <b>T10 – 10 points</b>	T 11 – 13 - 8 points, <b>T14 – 12 points</b>	80	<b>200</b>

*T1-T14 – topics according to thematic plan*

**Module 2**

Ongoing assessment and selfstudy work			Final Module Control	Total
Submodule 4	Submodule 5	Submodule 6		
T 1 – T6 - 5 points, <b>T5 – 13 points</b>	T 8 – T11 - 5 points, <b>T12 – 13 points</b>	T 13 – 18 - 5 points, <b>T19 – 14 points</b>	80	<b>200</b>

*T1-T19 – topics according to thematic plan*

When mastering each topic of the module for the current academic activity, students are given grades on a 4-point traditional scale, which are then converted into points, depending on the number of topics in the module. The program used the following system to convert a traditional scoring system:

Traditional mark	Convert to points	
	Module 1	Module 2
"5"	8	5
"4"	6,4	4
"3"	4,8	3
"2"	0-4,7	0-2,9

The maximum amount that a student can gain in studying a module is 200 points. It is calculated by multiplying the number of points corresponding to the grade "5" by the number of topics in the module. The minimum number of points a student can earn when studying a module is calculated by multiplying the number of points corresponding to the grade "3" by the number of topics in the module.

**Evaluation of independent work:**

Assessment of students' independent work, which is provided in the subject along with the classroom work, is carried out during the ongoing control of the topic in the relevant classroom.

Assessment of topics that are presented only for independent work and are not included in the topics of classroom training, is controlled by the final module control.

**Final modular control:**

The final module test work is done by computer and written testing. The form of the final module control should be standardized and include control of theoretical and practical training.

The maximum number of points that a student can receive is 80 points: 40 points for computer-based testing, 40 points - written tests. The final module control is considered to be enrolled if the student has scored at least 50 points.

Passing the test control of the test from the bases and booklets of STEP 1 is obligatory for all students. Mandatory test control is considered to be made subject to successful completion of at least 80% of the proposed tests. Students who have not passed the compulsory test control are not admitted to the final control of the discipline. The final module control is carried out upon completion of the study of all topics of the module.

There are three theoretical questions for writing Module 1 on Module 1. Each assignment is rated at 13, 13 and 14 points, respectively.

There are five tasks for writing control of Module 2, three of which are theoretical questions on Module 2 topics and two situational tasks. Each theoretical question is rated at 10 points and each situational task is scored at 5 points.

30 computer-based tests are offered for computer-based student control testing. Step 1. Each test task is rated at 1.3 points, the maximum score is 40, and the student must score 80% (32 points) for successful computer-based testing.

**Examples of computer testing tasks:**

1. In the examination of the patient's blood, a significant increase in the activity of CF forms of CFK (creatine phosphokinase) and LDG-1 was found. Which pathology can be assumed?

- A. Hepatitis
- B. Rheumatism
- C. Pancreatitis
- D. Cholecystitis
- E. Myocardial infarction

Correct Answer: E.

2. In a 72-year-old man, long-term chronic pulmonary pathology resulted in insufficiency of valves of the pulmonary artery and tricuspid valve, insufficiency of blood circulation by the right ventricular type. What type of hypertension is causing heart overload by volume?

- A. Pulmonary hypertension
- B. Central ischemic hypertension
- C. Essential hypertension
- D. Reflexogenic hypertension
- E. Salt hypertension

Correct Answer: A.

3. The patient with a transmural myocardial infarction of the left ventricle is transferred to separation of resuscitation in a serious condition. AT- 70/50 mmHg, HR-56 / min, BR-32 / min. Please identify the main link in the pathogenesis of cardiogenic shock:

- A. Falling cardiac output
- B. Peripheral vascular resistance drop
- C. Water loss
- D. Blood loss
- E. Loss of electrolytes

Correct Answer: A.

4. An athlete (long distance runner) developed acute heart failure during the competition. What caused this pathology?

- A. Heart overload by volume
- B. Disorders of the coronary circulation
- C. Direct damage to the myocardium
- D. Pathology of the pericardium
- E. Heart overload resistance

Correct Answer: A.

5. A patient in his 50s suffers from hypertension. During physical exertion, he had a feeling of weakness, lack of air, blueness of the mucous membrane of the lips, skin of the face. Breathing was accompanied by sensations of distant moist wheezing. What is the mechanism underlying this syndrome?

- A. Chronic right ventricular failure
- B. Acute left ventricular failure
- C. Chronic left ventricular failure
- D. Collapse
- E. Heart tamponade

Correct Answer: B.

## **LIST OF THEORETICAL QUESTIONS FOR WRITTEN CONTROL:**

### **MODULE 1. GENERAL PATHOLOGY**

#### **Content module 1. General doctrine of disease, etiology and pathogenesis. Pathogenic effect of environmental factors. The role of internal factors in pathology**

1. The subject and tasks of pathophysiology, communication with other sciences, importance for the clinic. Pathophysiology as a discipline.
2. Methods of pathophysiology. An experiment, its importance for solving fundamental problems of medicine. Types of experiment. The main stages of experimental research. Modern methods and techniques for modeling pathological processes.
3. History of the development of pathophysiology in Ukraine (N.A. Khrzonshevsky, V.V. Pidvysotsky, O.O. Bogomolets, O.V. Reprev, D.O. Alpern).
4. Basic concepts of nosology: health, illness, pathological condition, pathological process, typical pathological process, pathological reaction.
5. The main directions of the doctrine of the disease (humoral, solidarity, cellular), their current state.
6. Philosophical, medical, biological and social aspects of the doctrine of disease. Principles of classification of diseases.
7. Universal periods in the development of the disease. Disease completion options. Concepts of terminal conditions: agony, clinical death, biological death. Principles of resuscitation.
8. Definition of the term "etiology". The main directions of the doctrine of etiology: mono-causalism, conditioning, constitutionalism, psychosomatic concept. The problem of causality in pathology, the current state of its solution.
9. Classification of etiological factors, the concept of risk factors. "Diseases of civilization".
10. Principles of etiotropic, pathogenetic and symptomatic therapy.
11. Definition of the term "pathogenesis". Pathological (destructive) and adaptive - compensatory (protective) phenomena in pathogenesis (on the examples of acute radiation sickness, inflammation, blood loss).
12. Causation, role of circulusvitiosus in pathogenesis; concept of the main and secondary links of pathogenesis. Specific and nonspecific mechanisms of disease development.
13. Patterns of development of mechanical trauma. Traumatic shock. Crash-syndrome.

14. General and local effect of thermal factors on the body. Pathological and adaptive-compensatory changes in the pathogenesis of hypo- and hyperthermia.
15. Mechanisms of pathogenic effect of ionizing radiation on the body. Fabric radiosensitivity. General characteristics of forms of radiation damage.
16. Local and general effects on the body of ionizing radiation. Acute radiation disease, its forms. Pathogenesis of bone marrow forms of acute radiation sickness. Long-term effects of ionizing radiation.
17. Pathogenic effects of excessive and insufficient UV absorption. Photosensitization.
18. Effects on the organism of high and low atmospheric pressure. Pathogenesis of compression syndromes and decompression. Explosive decompression.
19. Chemical pathogenic factors as a problem of ecology and medicine. Toxicity, carcinogenicity, teratogenicity of chemical compounds. Exointoxication. Pathophysiological aspects of smoking, alcoholism and drug addiction.
20. Infectious process, general patterns of development. Mechanisms of protection of an organism against infection.
21. Hereditary and congenital diseases. Mutations as a cause of hereditary diseases (types, causes, consequences of mutations). Mutagenic effects. Impairment of DNA repair and elimination of mutant cells as risk factors for mutation accumulation and disease.
22. Characterization of monogenic diseases by type of inheritance. Molecular and biochemical basis of pathogenesis of monogenic diseases with classical type of inheritance: defects of enzymes, receptors, transport, structural proteins and proteins that regulate cell division.
23. Pathogenesis of monogenic diseases with non-classical inheritance. Polygenic (multifactorial) diseases.
24. Chromosomal diseases, their etiology, pathogenesis. General characteristics of Down syndromes, Klinefelter, Shereshevsky - Turner. The role of chromosomal aberrations in the etiology and pathogenesis of tumors.
25. Principles of diagnostics of hereditary diseases. Cytological methods. Methods of DNA diagnostics. Principles of prevention and treatment of hereditary diseases.
26. Constitutional anomalies as a risk factor for the occurrence and development of diseases. Classifications of constitutional types by Hippocrates, Sigo, Kretzmer, Sheldon, I.P. Pavlov, OO Bogomolets, MV Chornorutsky.
27. Aging. Structural, functional and biochemical manifestations of aging. Progeria. Modern theories of aging.
28. The concept of prenatal pathology. Gameto-, blast-, embryo- and fetopathy. Teratogenic factors. Critical periods in prenatal ontogeny. Pre-natal dystrophy, infection, hypoxia. Diseases and bad habits of the mother as causal or risk factors for fetal pathology.
29. The role of reactivity in pathology. Reactivity and resistance: definitions, types, mechanisms. Dependence of reactivity on age, sex, heredity, state of nervous and endocrine systems.
30. The role of the physiological system of connective tissue in the resistance of the body to the action of pathogenic agents (O.O. Bogomolets). Biological barriers, their classification.
31. General characteristics of immune system disorders: abnormal immune response to exoantigens and loss of tolerance to autoantigens. Mechanisms of immune system tolerance to autoantigens. Causes and consequences of its cancellation.
32. Types of immune deficiency. Etiology, pathogenesis of primary and secondary immunodeficiencies. Typical manifestations of immune deficiency.
33. Etiology, pathogenesis of AIDS. Pathophysiological characteristics of HIV infection periods. Typical clinical manifestations. Principles of prevention and therapy of HIV infection.
34. Classification of immune responses to the mechanisms of cell damage and dysfunction (by Coombs and Jell).
35. Definition of the term "allergy", principles of classification of allergic reactions. The multifactorial nature of allergic diseases. Classification and characterization of allergens.

36. Type 1 allergic reactions (anaphylactic), according to Coombs and Jell. Etiology, pathogenesis, clinical manifestations of local and systemic anaphylactic reactions. Anaphylaxis mediators. "Pseudo anaphylactic" reactions.
37. Type 2 allergic reactions (cytotoxic, antibody-mediated) by Coombs and Jell. Etiology, pathogenesis, clinical manifestations.
38. Type 3 allergic reactions (mediated by immune complexes) by Coombs and Jell. Etiology, pathogenesis, clinical manifestations of local and systemic reactions. Serum disease.
39. Type 4 (cell mediated) allergic reactions by Coombs and Jell. Etiology, pathogenesis, clinical manifestations.
40. Type 5 allergic reactions (antibody-mediated cellular dysfunction). Etiology, pathogenesis, clinical manifestations.
41. Autoimmune reactions / diseases: general characteristics, principles of classification, current concepts of etiology and pathogenesis.
42. Fundamentals of organ and tissue transplantation. Causes and mechanisms of transplant rejection, prevention. "Transplant versus host" reactions.

### **Content module 2. Typical pathological processes**

1. Cell damage, principles of classification. Cell death (necrosis, apoptosis), their signs.
2. Universal mechanisms of cellular damage.
3. Mechanisms of cell protection and adaptation of cells to the action of damaging factors.
4. Arterial and venous hyperemia: definitions, manifestations, types, causes and mechanisms of development, options for completion and consequences.
5. Ischemia: definition of concepts, manifestations, types, causes, mechanisms of development, consequences. Mechanisms of ischemic cell damage. Ischemia syndrome is reperfusion.
6. Thrombosis: definition of the term, types of blood clots. Causes, mechanisms, consequences of thrombus formation.
7. Embolism: definition of the concept, types of emboli. Features of pathogenesis of embolism of large and small circulatory system, portal vein system.
8. Stasis: definition of the concept, types, causes, pathogenesis, consequences.
9. Disturbances of microcirculation, classification. Sludge syndrome: definition of the concept, causes and mechanisms of development. Disorders of local lymph circulation, types, causes and mechanisms of development.
10. Inflammation: definition of the concept, principles of classification. Characteristics of acute and chronic inflammation. General manifestations and local signs of inflammation. Etiology of inflammation.
11. Pathogenesis of acute inflammation, stage. The combination of pathological and adaptive-compensatory changes in the dynamics of acute inflammation. Alteration, types, causes, mechanisms.
12. Inflammatory mediators, their classification. Mechanisms of formation and biological action of plasma inflammatory mediators.
13. Mediators of inflammation of cellular origin; characterization of their biological effects.
14. Changes in local circulation in inflammation (by J. Congame). Pathogenesis of individual stages of vascular response in the focus of acute inflammation.
15. Exudation in the inflammatory cell, its causes and mechanisms. Phases of increase of permeability of a vascular wall. Types of exudates.
16. Leukocyte emigration into the inflammatory cell. Sequence, causes and mechanisms of leukocyte emigration. The role of leukocytes in the development of local and general manifestations of inflammation. Mechanisms of microbial destruction by leukocytes.
17. Phagocytosis is immune and non-immune. Disruption of phagocytosis.
18. Metabolism disorders in the inflammatory cell.
19. Cell proliferation in the inflammatory cell, its mechanisms. Mechanisms of mitogenic action of growth factors and cytokines. Regeneration and fibroplasia as ways of healing.

20. The role of the reactivity of the organism in the development of inflammation. The link between a pathological immune response and inflammation. Influence of hormonal factors on inflammation.
21. Fever: definition of the concept, principles of classification. The link between fever and inflammation. Types of pyrogens. Formation of pyrogens during infection, aseptic injury and immune responses. Chemical nature and origin of secondary pyrogens, mechanism of their action.
22. Fever: stages of development, changes in thermoregulation, metabolism and physiological functions. Protective value and pathological manifestations of fever. Principles of antipyretic therapy. The concept of pyrotherapy.
23. The main differences between fever, exogenous overheating and other types of hyperthermia.
24. Tumor: definition of the concept, principles of classification of tumors. General patterns of tumor growth. Molecular - genetic bases of endless growth and potential immortality of tumor cells.
25. Typical properties of benign and malignant tumors. Types of anaplasia. Ways and mechanisms of metastasis.
26. Etiology of tumors. General characteristics of carcinogens. Risk factors (genetic / chromosomal defects, constitutional anomalies) and conditions for the origin and development of tumors.
27. Physical carcinogens. Chemical carcinogens: principles of classification, characterization of major groups. Mechanisms of chemical carcinogenesis. Coccinogenesis and syncancerogenesis.
28. Biological carcinogenic factors. Classification of oncogenic viruses. Virus - associated tumors in animals and humans. Mechanisms of viral carcinogenesis.
29. Pathogenesis of tumor growth. The role of disorders of molecular (genetic) mechanisms of regulation of cell division in the process of tumor transformation. Methods of conversion of protooncogenes to oncogenes. Properties of oncoproteins.
30. Tumor progression: definition of the concept, causes and mechanisms, typical features. Mechanisms of invasive growth and metastasis. Acquisition of resistance to chemotherapy. Influence of a tumor on an organism. Pathogenesis of cancer cachexia.
31. Mechanisms of natural antitumor protection, immune and non-immune.
32. Hypoxia: definition of a concept, classification.
33. Respiratory hypoxia.
34. Hemic hypoxia.
35. Circulatory hypoxia.
36. Tissue hypoxia.

### **Content module 3. Pathology of metabolism and energy**

1. Disorders of energy metabolism: etiology, pathogenesis, consequences. The concept of energy needs of the body, positive and negative energy balance. Changes in the main exchange in pathology.
2. Characteristics of disorders of carbohydrate metabolism; criteria for euglycemia, hypoglycemia, hyperglycemia, impaired glucose tolerance. The role of changes in neuronal-humoral regulation of carbohydrate metabolism in the pathogenesis of hypo- and hyperglycemic conditions.
3. Causes and mechanisms of development of hypoglycemic conditions. Pathogenesis of hypoglycemic coma.
4. Definition, classification of diabetes mellitus (WHO). General characteristics of the main types of diabetes (type of insulin deficiency, its origin, features of the course, typical manifestations, complications and treatment principles).
5. Etiology of type 1 diabetes (the value of hereditary factors and environmental factors in the development of absolute insulin deficiency). Pathogenesis of type 1 diabetes: impaired protein, carbohydrate, fat, water-electrolyte metabolism and acid-base status. Clinical manifestations.
6. Etiology, pathogenesis of type 2 diabetes. The role of hereditary factors. Causes of relative insulin deficiency. Metabolism and physiological functions. Clinical manifestations.
7. Complications of diabetes. Causes and mechanisms of various types of coma in diabetes. Long-term complications of diabetes.

8. Experimental modeling of diabetes mellitus. Principles of prevention and therapy of its main types. Prevention of complications of diabetes.
9. Disorders of lipid metabolism: causes, mechanisms, manifestations. Dependence of development of dyslipoproteinemias on environmental factors, heredity, comorbidities. Principles of classification of dyslipoproteinemias. Etiology and pathogenesis of primary (hereditary) and secondary hyperlipoproteinemias.
10. Obesity: definition of concept, classification; etiology and pathogenesis of individual forms. Experimental modeling of obesity. Medical problems associated with obesity.
11. Positive and negative balance of nitrogen. Types of hyperazotemia. Changes in the protein composition of the blood. Hereditary disorders of amino acid metabolism.
12. Violation of purine and pyrimidine metabolism. Etiology, pathogenesis of gout.
13. Hypo- and hypervitaminosis: types, causes and mechanisms of development. Pathogenesis of the main clinical manifestations. Principles of correction of vitamin deficiency.
14. Violation of water-salt exchange. Forms of hyper- and hypohydria, their etiology, pathogenesis, consequences. Disorders of sodium and potassium metabolism: causes, mechanisms, clinical manifestations.
15. Edema: definition, concepts, types, causes and mechanisms of edema (according to Starling).
16. Acidosis: definition of the concept, classification, causes of development. Compensatory and pathological reactions. Indicators of acid-base status in different types of acidosis, principles of correction.
17. Alkalosis: definition of the concept, classification, causes of development. Compensatory and pathological reactions. Indicators of acid-base state in different types of alkalosis, principles of correction.

## **MODULE 2. PATHOPHYSIOLOGY OF BODIES AND SYSTEMS**

### **Content module 4. Pathophysiology of the blood system**

1. Disorders of total blood volume: classification, causes and mechanisms of development. Etiology, pathogenesis of blood loss. Pathogenesis of posthemorrhagic shock.
2. Erythrocytosis: definition of the concept, species, their etiology, pathogenesis.
3. Anemia: definition of the concept, principles of classification. Regenerative, degenerative, pathological forms of red blood cells. Posthemorrhagic anemia: types, causes, pathogenesis, blood picture.
4. Hemolytic anemia, classification; causes and mechanisms of erythrocyte hemolysis. Clinical and hematological characteristics of different types of hemolytic anemias.
5. Iron deficiency anemia: causes and mechanisms of development, typical changes in peripheral blood, pathogenesis of the main clinical manifestations. Iron refractory anemia.
6. Causes and mechanisms of development of vitamin B12 and folic acid deficiency. Characteristics of general disorders in the body in deficiency of vitamin B12 and/or folic acid. Hematologic characteristics of vitamin B12- and folic deficiency anemia.
7. Leukocytosis: types, causes and mechanisms of development. Concomitant nuclear shifts of neutrophilic granulocytes. Leukemoid reactions.
8. Leukopenia: types, causes and mechanisms of development. Agranulocytosis. Neutropenia. Concomitant nuclear shifts of neutrophilic granulocytes.
9. Leukemia: definition of the concept, principles of classification. Etiology of leukemias. Genotype anomalies and constitution as risk factors for leukemia.
10. Violation of cellular composition of bone marrow and peripheral blood in acute and chronic leukemias. Pathogenesis of leukemia: progression, metastasis, systemic disorders. Principles of diagnosis and treatment of leukemia.
11. Disorders of vascular-platelet hemostasis. Etiology and pathogenesis of vasopathy, thrombocytopenia, thrombocytopathy.

12. Insufficiency of coagulation hemostasis. Causes and mechanisms of disorders of individual stages of blood coagulation.
13. Disseminated intravascular coagulation syndrome, principles of classification, etiology, pathogenesis, clinical manifestations. Role in pathology.

#### **Content module 5. Pathophysiology of external breathing and cardiovascular system**

1. Insufficiency of external respiration: definition of the concept, principles of classification. Pathogenesis of the main clinical manifestations. Shortness of breath: types, causes, mechanisms of development.
2. Dysregulatory disorders of alveolar ventilation. Causes and mechanisms of pathological breathing (disturbance of frequency, depth, rhythm). Pathogenesis of periodic breathing.
3. Alveolar ventilation disorders. Obstructive and restrictive mechanisms of development.
4. Causes and mechanisms of disorders of gas diffusion in the lungs. Disorders of the pulmonary circulation. Disorders of general and regional ventilation-perfusion relationships in the lungs.
5. Asphyxia: definition of the concept, causes, pathogenesis. Terminal respiration.
6. Circulatory insufficiency: definition of the concept, principles of classification, causes and mechanisms of development of its various types. Pathogenesis of the main clinical manifestations of chronic circulatory insufficiency.
7. Heart failure: definition of the concept, principles of classification. Causes of heart overload by volume and resistance. Mechanisms of immediate and long-term adaptation of the heart to overload. Heart hypertrophy, its pathogenesis (according to F. Meerson). Features of hypertrophied myocardium.
8. Myocardial heart failure. Etiology, pathogenesis of non-coronary myocardial damage. Experimental modeling.
9. Cardiomyopathy: definition of the concept, principles of classification; etiology, pathogenesis.
10. Insufficiency of coronary circulation: definition of the concept, causes and mechanisms of development, clinical manifestations. Mechanisms of ischemic and reperfusion injury of cardiomyocytes.
11. Ischemic heart disease: types, etiology, pathogenesis, clinical manifestations. Pathogenesis of manifestations and complications of myocardial infarction.
12. Extra-myocardial heart failure. Pericardial lesions. Acute tamponade of the heart, manifestations and consequences.
13. Hypertension: definition of the concept, principles of classification. Primary and secondary arterial hypertension. Hemodynamic variants.
14. Causes and mechanisms of development of secondary arterial hypertension, experimental modeling.
15. Primary arterial hypertension as a multifactorial disease; current ideas about the etiology and pathogenesis of hypertension. The role of the kidneys in the pathogenesis of primary arterial hypertension.
16. Hypertension of a small circle of circulation (primary, secondary). Causes and mechanisms of development. Clinical and hemodynamic manifestations.
17. Hypotension. Etiology and pathogenesis of acute and chronic arterial hypotension.
18. Arteriosclerosis: definition, classification. Characteristics of the main forms: atherosclerosis (Marshana), mediocalcinosis (Menkeberg), arteriosclerosis.
19. Atherosclerosis. Etiology of atherosclerosis: risk factors, causative factors. Modern theories of atherogenesis are "inflammatory" and "receptor". The role of hereditary and acquired disorders of receptor-mediated lipoprotein transport in atherogenesis.
20. Arrhythmias of the heart. Experimental modeling. Causes, mechanisms of disorders of automatism, excitability, conductivity, typical electrocardiographic manifestations.
21. Causes, mechanisms of disorders of automatism and ECG reproduction.
22. Causes, mechanisms of excitability and ECG reproduction.
23. Causes, mechanisms of conductivity disorders and ECG reproduction.

## **Content module 6. Pathophysiology of the digestive system, liver and kidneys.**

### **Pathophysiology of regulatory systems and extreme conditions**

1. Causes and mechanisms of indigestion in the mouth. Etiology, pathogenesis, experimental models of caries and periodontal disease. Causes, mechanisms of salivary disorders.
2. General characteristics of disorders of the motor and secretory functions of the stomach. Pathological gastric secretion, its types. Role of nervous and humoral mechanisms in violation of secretion.
3. Etiology, pathogenesis of gastric and / or duodenal ulcer. Etiology, pathogenesis of symptomatic gastric and / or duodenal ulcers.
4. Disorders of the cavity digestion in the intestines; causes, mechanisms, manifestations. Disorders related to pancreatic insufficiency. Pancreatitis: types, causes; pathogenesis of acute pancreatitis. Pancreatic shock.
5. Suction disorders. Causes and mechanisms of malabsorption, pathogenesis of the main clinical manifestations.
6. Intestinal dyskinesia. Causes and mechanisms of constipation and diarrhea. Intestinal obstruction: species, etiology, pathogenesis.
7. Liver failure: definition of the concept, principles of classification, causes, experimental modeling.
8. Typical disorders of carbohydrate, protein, lipid, water-electrolyte metabolism, metabolism of vitamins and hormones, systemic disorders in the body in case of liver failure.
9. Causes, mechanisms, clinical manifestations of insufficiency of antitoxic function of the liver. Theories of pathogenesis of hepatic coma.
10. Insufficiency of the excretory function of the liver: causes, mechanisms, clinical manifestations. Violation of the exchange of bile pigments in various types of jaundice. Cholemic and acholic syndromes.
11. Violation of hemodynamic function of the liver. Portal hypertension syndrome: etiology, pathogenesis, clinical manifestations.
12. Causes and mechanisms of impaired filtration, reabsorption and secretion in the kidneys. Functional tests for renal impairment.
13. Causes and mechanisms of development of quantitative and qualitative changes in the composition of urine: oliguria, anuria, polyuria; hypostenuria, isostenuria; proteinuria, hematuria, cylindruria, leukocyturia.
14. Syndrome of acute renal failure: definition of the concept, causes and mechanisms of development, clinical manifestations. Nephrotic syndrome.
15. Chronic renal failure syndrome: definition of the concept, causes and mechanisms of development, clinical manifestations. Pathogenesis of uraemic coma.
16. General manifestations of renal failure. Pathogenesis of edema, hypertension, anemia, haemostasis disorders, acid-base condition, osteodystrophy.
17. Glomerulonephritis: definition of the concept, principles of classification, experimental models. Etiology, pathogenesis of diffuse glomerulonephritis.
18. Typical disorders of the endocrine glands, their causes and mechanisms of development. Disorders of direct and inverse regulatory links in the pathogenesis of dysregulatory endocrinopathy.
19. Glandular endocrinopathy. Causes and mechanisms of disorders of biosynthesis, deposition and secretion of hormones.
20. Peripheral disorders of endocrine function. Disorders of transport and inactivation of hormones. Disorders of hormone reception. Mechanisms of hormonal resistance.
21. Pathology of the neuroendocrine system. Causes and mechanisms of development of syndromes of excess and lack of pituitary hormones, their general characteristics.
22. Adrenal insufficiency, acute and chronic: causes and mechanisms of development, pathogenesis of the main clinical manifestations.
23. Adrenal cortex hyperfunction. Itsenko-Cushing's syndrome. Primary and secondary hyperaldosteronism. Syndrome of congenital adrenal hyperplasia (adrenogenital syndrome). Causes, mechanisms, clinical manifestations.

24. Hypothyroidism: causes and mechanisms of development, pathogenesis of the main clinical manifestations.
25. Hyperthyroidism: causes and mechanisms of development, pathogenesis of the main clinical manifestations.
26. Goiter: species, etiology, pathogenesis; disorders of the functional state of the thyroid gland.
27. Hypo- and hyperfunction of parathyroid glands: etiology, pathogenesis, typical disorders in the body.
28. Impaired genital function: primary and secondary states of hyper- and hypogonadism. Etiology, pathogenesis, typical clinical manifestations.
29. Stress. Definition of the concept, causes and mechanisms of development, stages. The concept of "adaptation diseases".
30. General characteristics of pathology of the nervous system, principles of classification of disorders of its activity. Features of the development of typical pathological process in the nervous system. The role of changes in the blood-brain barrier in the pathogenesis of CNS disorders.
31. Violation of the sensory function of the nervous system. Disorders of mechano-, thermo-, proprio- and nociception. Violation of sensory information. Manifestations of damage to the thalamic centers and sensory structures of the cerebral cortex.
32. Pain. Principles of classification. Somatic pain. Contemporary ideas about the causes and mechanisms of pain development: impulse distribution theory, specificity theory. Pathological pain. The body's reactions to pain. Natural antinociceptive mechanisms.
33. Disorders of the motor function of the nervous system. Experimental modeling of movement disorders. Peripheral and central paralysis and paresis: causes, mechanisms, manifestations. Spinal shock. Motor disorders of subcortical origin. Cerebral lesions. Cramps. Myasthenia gravis.
34. Violation of the autonomic functions of the nervous system, methods of experimental modeling. Vegetative vascular dystonia syndrome.
35. Violation of trophic function of nervous system. Neurogenic dystrophy. Structural, functional and biochemical changes in the denervated organs and tissues.
36. Causes and mechanisms of disturbances of electrophysiological processes in neurons. Impaired ion channel function, impaired neurochemical processes. Mechanisms of pathological excitation and pathological inhibition of nerve centers.
37. Damage to neurons as a cause of disorders of integrative functions of the nervous system.
38. Acute and chronic disorders of cerebral circulation. Stroke. Edema and swelling of the brain. Intracranial hypertension.
39. The concept of extreme conditions. General characteristics.
40. Causes and mechanisms of development of shock states, clinical and pathophysiological manifestations.
41. Coma: definitions, varieties; causes and mechanisms of development of coma.

### **List of practical tasks**

1. Solution of situational problems with determination of causal factors, risk factors, the main link of pathogenesis. Conclude.
2. To draw diagrams and explain the mechanisms of immune damage in the pathogenesis of allergic reactions according to Coombs and Jell. To solve a situational problem, to draw a conclusion.
3. To draw diagrams and explain the stages of pathogenesis of typical pathological processes, cause and effect (changes local and general, pathological and adaptive compensatory). To solve a situational problem, to draw a conclusion.
4. To draw diagrams and explain the cause and effect relationships in the pathogenesis of typical disorders of carbohydrate, water-electrolyte, fat and protein metabolism and acid-base status, while characterizing the changes pathological and adaptive-compensatory.
5. To determine typical metabolic disorders based on the results of laboratory tests.
6. To draw diagrams and explain the pathogenesis of comatose conditions in diabetes mellitus.

7. To determine the pathogenetic variant of anemia in a patient on the basis of anamnesis, hemogram data, description of peripheral blood smear.
8. To calculate the absolute number (g/l) of individual leukocyte species in the blood based on the total number and leukocyte formula, interpret the result.
9. To determine the type of nuclear shift of neutrophil granulocytes (left, right) in the analysis of the provided leukogram.
10. To determine the type of nuclear shift of neutrophilic granulocytes to the left in the analysis of the provided leukogram.
11. To characterize the violation of qualitative and quantitative composition of "white blood" according to the leukogram of a patient with chronic myelogenous leukemia.
12. To determine the type of nuclear shift of neutrophilic granulocytes in the leukogram of a patient with chronic myelogenous leukemia.
13. Characterize the violation of qualitative and quantitative composition of "white blood" in the leukogram of a patient with chronic lymphocytic leukemia.
14. On the basis of hemogram study to characterize changes of qualitative and quantitative composition of blood in patients with acute leukemia.
15. To solve a situational problem with the definition of typical disorders in the blood system (erythrocytosis, anemia, leukocytosis, leukopenia, leukemia; hemostasis disorders), their main varieties (through the application of knowledge of the principles of their classifications), causes and mechanisms of development.
16. To determine the main pathological process in the heart and lungs based on the results of laboratory and instrumental examination (blood test, ECG, spirometry, pneumotachometry).
17. On the basis of an ECG to evaluate the violation of automatism, conductivity, excitability of different departments of the heart.
18. Analyze typical electrocardiogram abnormalities with coronary insufficiency.
19. Solution of situational problems with determination of causes, mechanisms of development of jaundice.
20. To draw diagrams and explain disorders of pigment metabolism in different types of jaundice.
21. On the basis of laboratory analysis to determine indicators of gastric secretion and to apply them for the analysis of typical disorders of secretory function.
22. To calculate the magnitude of glomerular filtration rate for clearance of endogenous creatinine, to determine the intensity of tubular reabsorption of water and electrolytes and to use them for the analysis of impaired renal function.
23. On the basis of the results of laboratory tests to evaluate the state of kidney function, to determine typical disorders of quantitative and qualitative composition of urine.
24. Solution of situational problems with determination of typical violations in regulatory systems through application of knowledge of causes and mechanisms of development.

#### **Evaluation criteria for the final semester control**

Assessment of the course "Pathophysiology" is given only to students who have enrolled all modules in the discipline.

The discipline grade is given as the average of the grades for the modules for which the discipline is structured.

Conversion of discipline points into ECTS and 4-point (traditional) scores:

Assessment in FX, F ("2") is given to students who do not enroll in at least one module after completing their course.

Assessment in FX ("2") is given to students who have not earned a minimum of points in their current academic activities or have not completed a modular final examination. They are entitled to re-take the final module control, no more than 2 times during the winter holidays and within two (additional) weeks after the end of the spring semester according to the schedule.

Students who have received a grade of F ("2") after completing the course (who have not completed at least one module or have not earned a minimum of credits for their current course activity) must retake the individual curriculum.

Total of points for all kinds of educational activity	ECTS	Score on a national scale	
		For exam, course project (work), practice	For credit
180 – 200	<b>A</b>	excellent	passed
164-179	<b>B</b>	good	
148-163	<b>C</b>		
128-147	<b>D</b>	satisfactorily	
120-127	<b>E</b>		
70-119	<b>FX</b>	unsatisfactory with the possibility of reassembly	didn't pass with option to retake
0-69	<b>F</b>	unsatisfactory with the compulsory re-study of the discipline	didn't pass without option to retake

## 6.1 The program on the Pathophysiology

### Module I. General pathology

#### CONTENT MODULE I. General nosology

General nosology as a general study about illness, etiology and pathogenesis. Pathogenic action of factors of external environment. A role of internal factors in pathology

**Exact aims:**

- *To explain the basic concepts of general nosology: health, illness, pathological process, typical pathological process, pathological reaction, pathological state, etiology, pathogenesis.*
- *To explain the basic concepts of etiology: causal factors, factors of risk, conditions of origin and development of illness, to analyze the different variants of development of causative-consequence mutual relations in pathogenesis.*
- *To analyze pathological and adaptive-compensatory phenomena in pathogenesis, local and general, specific and nonspecific, to select the leading link of pathogenesis.*
- *To estimate the role of modern methods of researches (experimental and clinical) for a pathophysiology.*
- *To analyze the role of factors of environment in the origin of illnesses.*
- *To analyze the general mechanisms of pathogenic action of factors of external environment on an organism.*
- *To explain the mechanisms of pathogenic action of physical, chemical and biological factors of external environment.*
- *To explain causative-consequence relationships, to distinguish local and general changes, pathological and adaptive-compensatory actions in pathogenesis of factors of external environment (overheat, cooling, burns, frostbites, radiation sickness, illnesses of decompression and compression).*
- *To determine and analyze the role of anomalies of constitution, fetal development and heredity, role of ageing changes and disorders of reactivity in development of diseases.*
- *To characterize the etiologic factors of origin and development of the inherited illnesses and disorders of fetal development.*

### **Theme 1. Subject, tasks and methods of pathophysiology.**

Pathophysiology as a science. A place of pathophysiology is in the system of medical sciences. A role of achievements of molecular biology, genetics, biochemistry, physiology, immunology and other sciences in the development of modern pathophysiology. A role of pathophysiology for clinical and prophylactic medicine. Clinical pathophysiology.

Pathophysiology as an educational discipline, its component parts: general pathology, pathophysiology of organs and systems. A place of pathophysiology in the system of preparation of doctor.

Methods of pathophysiology. An experimental modelling of pathological processes (diseases) is a basic method of pathophysiology - its abilities and limitations. Modern experimental methods, rules of work with experimental animals. Experimental therapy. Methods of clinical pathophysiology.

History of development of pathophysiology. The role of the advanced studies of Bernar, Virkhov, Konheim, Mechnikov, Pashutin, Selie and other prominent researchers.

General study about illness, etiology and pathogenesis.

Basic concepts of nosology: norm, health (WHO), illness, pathological process, typical pathological process, pathological reaction, pathological state.

Illness as biological, medical and social problem. Abstract and exact in a concept "illness".

Principles of classification of illnesses, classification of WHO. Basic laws to the law and periods are in development of illness. Variants of exitus of illnesses.

A concept of the terminal states (agony, clinical death) and biological death. Pathophysiological bases of reanimation.

Main directions of studies about illness: humoral (Hippocrates), solidar (Demokrit), cellular (Virkhov). Development of these directions at the modern state.

Determination of concept "etiology". A problem of causality in pathologies, modern state of its solving. Modern understanding of causal factors, factors of risk, condition of origin and development of illnesses.

Basic directions of development of studies about etiology: monocausalism, conditionalism, constitutionalism, psycho-somatic conception and others. Modern understanding of causality in pathology.

Classification of etiologic factors. External and internal etiologic factors. Ecological, genetic, cumulative and ontogenetic conception of origin of human illnesses. Etiotropic principle of treatment and prophylaxis of illnesses.

Determination of concept "pathogenesis". The pathological (destructive) and adaptative-compensatory (protective) phenomena in pathogenesis. Examples of damage at the different levels: molecular, cellular, tissue, organ, at the level of whole organism.

Protective adaptative reactions. Adaptation, compensation. Mechanisms of immediate and long duration adaptation. A role of nervous and humoral factors in their realisation.

Causative-consequence relationships, their variants. A concept about the "main link" of pathogenesis. The local and general phenomena, specific and nonspecific changes in pathogenesis. Unity of structural changes and functional signs of illness. Nosotropic principle of classification and treatment of illnesses.

### **Theme 2. Pathogenic effect of external factors on the human body.**

Pathogenic action of mechanical factors. Laws of development of mechanical trauma, syndrome of long duration squashing, prolonged compression syndrome, traumatic illness.

Pathogenic action of thermal factors. Protective, compensatory reactions and actually pathological changes at hyperthermia. Sunstroke. Burns, combustial illness. Hypothermia. Protective, Compensatory reactions and pathological changes. Mechanisms of long duration adaptation to cold. Artificial hypothermia, its use in medicine. Local action of low temperatures: frostbites.

Pathogenic action of radial energy. Types of ionizing radiation. Radiosensitivity of tissues. Mechanisms of direct and indirect radial damage of biological structures. Radiolysis of water.

Radiotoxins. Signs of radiation effects on molecular, cellular, tissue, organ and system levels. Pathogenesis of radiation illness, its basic forms and syndromes. The nearest and remote consequences of large and small doses of ionizing radiation. Its stochastic and not stochastic effects. Natural mechanisms of antiradiation defence. Pathophysiological bases of radioprotection.

Pathogenic effect of infrared and ultraviolet rays. Photosensitivity. The risk of insufficient insolation. Lesions caused by electromagnetic radio waves of ultrahigh frequency range.

Pathogenic effect of electric current. Factors that determine the nature of injuries.

Effects on the body of high and low atmospheric pressure. The causal relationship to the pathogenesis of syndromes compression and decompression. Explosive decompression.

### **Theme 3. The role of heredity, constitution and age-related changes in pathology.**

Heredity as a reason and condition of development of illnesses. Correlation of inherited and acquired in pathogenesis. Inherited and innate illnesses. Geno- and phenocopies. Classification of the inherited illnesses.

Mutations. Principles of their classification. Types of mutations. Reasons of mutations. Mutagenic factors of physical, chemical and biological origin. Systems of antimutational defence. Mechanisms of reparation of DNA. Role of disorders of the reparative systems and „immunological supervision" in the origin of the inherited pathology.

Monogenetic inherited illnesses. Characteristic of monogenetic illnesses according to the type of inheritance of pathological gene: 1) inherited classically, by Mendel (autosom-dominant and - recessive, codominant, fixed with the gender); 2) inherited non classically (caused by triplet repetitions, mitochondrial, at disorders of genomic imprinting). Signs of harmful gene mutations on molecular, cellular, organ levels and at the level of organism on the whole. Molecular and biochemical bases of pathogenesis of classic monogenetic illnesses: defects of enzymes, receptors and transport systems; defects of structure, function or amount of unenzymic (structural) albumens, and also defects of albumens which regulate a cellular division (familial cancer). General understanding of pathogenesis of monogenetic illnesses with nonclassical inheritance (caused by genes amplifications - syndrome of fragile X-chromosome, by the mutations of mitochondrial genes or disorders of genomic imprinting).

Polygenic (multifactor) illnesses. The inherited predisposition to illnesses.

Chromosomal illnesses. Mechanisms of origin of genomic and chromosomal mutations. Polyploidy, aneuploidy, deletion, duplication, translocation, inversion. Syndromes, caused by the change of amount of chromosomes. Basic phenotypic signs of chromosomal aberrations.

Methods of diagnostics, principles of prophylaxis and treatment of the inherited illnesses. Ways of correction of genetic defects. Prospects of the genetical engineering.

Constitution, its role in pathology. Classification of constitutional types by Hippocrates, Sigo, Sheldon, Krechmer, Pavlov. Anomalies of constitution as a risk factor of origin and development of illnesses.

A concept about antenatal pathology. Gameto-, blasto-, embrio- and fetopathies. Teratogenes. Critical periods in antenatal ontogenesis. Prenatal hypo- and hypertrophy. Prenatal infection and hypoxia. Pathology of placental circulation of blood.

Illnesses and harmful habits of mother as causal factors or factors of risk of origin and development of fetal pathology.

Aging. Factors which determine specific, individual and middle life-span. General features and peculiarities of aging. Structural, functional and biochemical signs of aging at the molecular, cellular, tissue, organ, systemic levels and at the level of organism on the whole. Theories of senescence. Senescence and illnesses. Progerias. Theoretical bases for lengthening of life-span. Methods of geroprotection.

### **Theme 4. Immune reactivity disorders. Allergy.**

Infectious process, general laws of development. Classification of pathogens. Protective barriers from infection, conditions of their overcoming. Distribution and dissemination of pathogens in an organism. Sepsis. The role of pathogen properties and reactivity in the development of infectious diseases.

Reactivity as condition of development of illnesses. Signs of reactivity on molecular, cellular, tissue, organ, systemic levels and at the level of organism on the whole. Types of reactivity. Dependence of reactivity from a gender, age, heredity, state of the immune, nervous and endocrine systems. Influence of factors of environment on reactivity of organism.

A concept about resistance. Passive and active resistance. Connection of resistance with reactivity. Mechanisms of nonspecific resistance. Biobarriers, their classification, role in resistance of organism. Disorder of phagocytosis: reasons, mechanisms, consequences. Humoral factors of nonspecific resistance of organism to the pathogens. The complement system and its disorders.

Mechanisms of immune response. Humoral and cell-type mechanisms of immunological tolerance, its types. General patterns of immune system disorders, hyper-, hypo- and dysfunction of the immune system. Experimental modeling of immune pathology. 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 (immunosuppressive) states. The pathogenesis of clinical manifestations of immune deficiency. The etiology and pathogenesis of acquired immunodeficiency syndrome (AIDS).

Pathophysiological basis of transplantation of organs and tissues. The reaction of transplant rejection, its causes and mechanisms. The reaction of "graft versus host".

Immunological relationships in the system "mother-fetus".

Basic principles of immunostimulation and immunosuppression.

Definition and general characteristics of allergies. Exogenous and endogenous allergens. Formation of allergic reactions depending on the condition of the body. The role of inherited and acquired factors in the development of allergies.

Principles of classification of allergic reactions. General characteristics of allergic reactions of immediate and delayed types. Classification of allergic reactions after Coombs and Jelly. Stages of pathogenesis of allergic reactions.

Anaphylactic reactions: experimental models, the main clinical forms. Immunological mechanisms of anaphylactic reactions, tissue basophils role in their development. Active and passive anaphylaxis, anaphylactic shock pathogenesis.

Cytotoxic reactions: experimental design, the main clinical forms. The mechanisms of cytolysis: complement-dependent cytolysis, antibody phagocytosis, antibody-cell cytotoxicity. The role of complement activation products and the development of cytotoxic reactions.

Immune complex reactions: the main clinical forms. Factors that determine the pathogenicity of immune complexes. Immune complex damage: local and general symptoms.

The cell mediated hypersensitivity reaction (delayed type hypersensitivity reaction): experimental reproduction, main clinical forms. Features immunological mechanisms. The role of lymphokines.

Allergic reactions of stimulatory and inhibitory type, clinical forms. Pseudoallergic reaction.

Autoimmune reactions and diseases. The causes and mechanisms of development.

Basic principles of prevention and treatment of allergic reactions. Hyposensitization. The relationship between allergies, immunity and inflammation.

## **Theme 5. Practical skills on the Theme "General nosology. Pathogenic effect of environmental factors. The role of internal factors in pathology. "Semantic module 1**

### **CONTENT MODULE 2. Typical pathological processes**

**Exact aims:**

- *To determine the concept of typical pathological processes: damage of cell, local disorders of blood circulation and microcirculation, inflammation, tumor, fever, hypoxia, starvation etc.*
- *To apply existent principles for classification of typical pathological processes.*
- *To analyze changes of structure, function and metabolism of cells in pathogenesis of cellular damage.*
- *To analyze causative-consequence relationships in pathogenesis of typical pathological processes, in order to separate changes local and general, pathological and adaptive-compensatory.*
- *To analyze the mechanisms of damage of cells in pathogenesis of typical pathological processes.*
- *To apply necessary methods for an experimental modelling and study of typical pathological processes.*
- *To explain the general biological role of typical pathological processes, their role in pathology, in particular in an origin and development of the certain groups of diseases.*

**Theme 6. Cell damage. Local circulatory disorders.**

Characteristic of concept of "damage". Principles of classification of cell damage. Structural, functional, physical-chemical, biochemical and thermodynamical signs of cell damage. Exo- and endogenous reasons of damage of cells: hypoxia, action of physical, chemical, pathogens, immunoreactions, genetic defects.

Characteristic of universal mechanisms of cell damage:

- O<sub>2</sub>-dependent (action of oxygen and his derivates - free radicals which cause molecular peroxidation, predominantly of lipids with activating of phospholipases, detergent action of lisophospholipids and free fatty acids);
- calcium-dependent (an increase of free calcium in cells, activating of phospholipases, proteases, endonucleases);
- caused by deficit of ATP or by primary disorders of membrane permeability and, as a result, electrolyte-osmotic mechanism of damage;
- as a result of development of intracellular acidosis ;
- caused by activation of proteolysis, denaturizing of albumens;
- conditioned by disorders of genetic apparatus of cell.

Mechanisms and signs of subcellular structures damage. Consequences of damage of cells. Necrosis and apoptosis, their characteristic signs. Exo- and endogenous inductors of apoptosis. Mechanisms of apoptosis.

Mechanisms of defence and adaptation of cells to the action of harmful agents. Cellular stress proteins. Heat shock proteins (HSP)

Basic forms of disorders of peripheral circulation of blood: arterial and venous hyperemia, ischemia, stasis, their types, reasons and mechanisms of development, external signs. A role of endothelial factors is in pathogenesis of local disorders of circulation of blood. Changes in tissues, caused by disorders of local circulation of blood, their role and consequences. A concept about reperfusion syndrome, ischemic toxicosis.

Thrombosis and embolism as reasons of local disorders of circulation of blood. Reasons and terms of thrombosis. Types of emboli, mechanisms of embolism. A role of reflex mechanisms in development of general disorders, caused by emboli. Features of course of emboli in large and small circles of circulation of blood, portal vein.

Typical disorders of microcirculation, intavessel disorders. Sludge-syndrome. Syndrome of disseminated intracellular blood coagulation. Capillary (real) stasis. Disorder of tone, mechanical integrity and permeability of microvessels. Extravessel disorders of microcirculation. Capillary trophic insufficiency.

Typical disorders of lymphokinesis. Mechanical, dynamic and resorbitive insufficiency of

lymphokinesis.

### **Theme 7. Inflammation.**

Determination of concept of inflammation. Classifications of inflammation (immune, nonimmune; infectious, noninfectious; acute, chronic; normo-, hypo-, hyperergic, etc). Etiology of inflammation: classification and characteristic of pathogenic factors. General and local signs of inflammation.

Pathogenesis of acute inflammation. Stages of inflammation. Alteration (primary and secondary), reasons and mechanisms of secondary alteration.

Biochemical, physical-chemical disorders in the core of inflammation.

Mediators of inflammation, their classification. Plasma mediators (proteins of acute phase, proteins of the complement system, pro- and anticoagulants, fibrinolysis, kinins).

Mediators of cellular origin, specific and nonspecific.

Cytokins: types, characteristic of action. Mediators from tissue basophilic cells. Eicosanoids.

Disorder of local circulation of blood in the focus of acute inflammation. Pathogenesis of ischemia and arterial hyperemia. Reasons of transition of arterial hyperemia into venous. Changes of rheologic properties of blood in the focus of acute inflammation.

Exudation in the focus of acute inflammation, reasons and mechanisms. Characteristic of exudates. Emigration of leucocytes in the focus of inflammation. Stages, reasons and mechanisms of emigration of leucocytes. Adhesive molecules of leucocytes and endothelial cells. Reasons and mechanisms of chemotaxis of leucocytes. Mechanisms of neutralizing of microbes by leucocytes:

stages, mechanisms of elimination of objects of phagocytosis.

Proliferation in the place of inflammation - regeneration and/or fibroplasia. Reasons and mechanisms of proliferation. Mitogenic signals (factors of growth, cytokins, hormones, absence of the contact slowing down of proliferation). Transmission of mitogenic signal by intracellular alarm ways. Role of mitogen activated protein kinases in stimulation of cellular division. Mechanisms of sclerosis, organization of scar.

Chronic inflammation. General characteristic, features of system and local signs (comparing with acute inflammation). Features of pathogenesis (infiltration, reparation/fibrosis, formation of granuloma).

Role of the reactivity of organism, pathological immune answer in the development of inflammation (normo-, hypo-, hyperergic inflammation).

Principles of anti-inflammatory therapy.

### **Theme 8 Fever. Tumors.**

Determination of concept. General characteristic of fever, its formation in onco- and phylogenesis. Etiology of fever. Characteristic of pyrogens. Primary and secondary pyrogens.

The formation of

pyrogens in infection, aseptic damage and immunoreactions. 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. Role of the nervous, endocrine and immune systems in the development of fever. Changes in the exchange of substances and physiological functions during the fever. Protective role and pathological signs of fever.

Pathophysiology principles of antipyretic therapy. The definition of pyrotherapy. Basic differences between the fever, exogenous overheat and other types of hyperthermia.

General characteristic of basic types of disorders of tissue growth (hypoplasia, hyperplasia).

Determination of "tumor" and "tumor process". General laws of tumor growth. Molecular genetic

bases of unlimited growth and potential immortality of tumorous cells. Anaplasia: signs of

structural, functional, physical and chemical, biochemical, antigen anaplasia. Characteristic of expansive and infiltrative (invasive) growth of tumors. Principles of classification of tumors.

Experimental study of etiology and pathogenesis of tumors: methods of induction, transplantation, explantation.

Etiology of tumors. Physical, chemical and biological carcinogenic factors. Properties of carcinogenic factors which determine their carcinogenic action.

Factors of risk (genetic/chromosome defects and anomalies of constitution) and condition of appearing and the development of tumors.

Physical carcinogenic factors. Main laws of blastomogen action of ionizing radiation and ultraviolet rays.

Chemical carcinogens, their classification. Exo- and endogenous carcinogens. Chemical carcinogens action. Features of chemical structure of substances which determine their cancerogenicity.

Biological carcinogenic factors: mycotic (aphlatoxin), viruses. Classification of oncogenic viruses. Viral cancerogenesis. Experimental proofs of viral origin of tumors.

Pathogenesis of tumor growth. Stages of pathogenesis: initiator, procourse and progression.

Stage of transformation (initiator). Immortalization and damage of cellular mechanisms of division as basic events of tumor transformation. Mutational and epigenome mechanisms of malignant transformation. Disorder of the system of genes which provide a cellular division. Concept of protooncogenes, oncogenes (cellular, viral), genes-suppressors of cellular division. Methods of transformation of protooncogene into oncogene. Types of oncoproteins. A role of apoptosis in pathogenesis of tumor growth. A concept about inductors and suppressors of apoptosis. Mechanisms of deviation of the transformed cells from an apoptosis. Characteristic of promoters of tumor growth (influences are hormonal, chemical matters, chronic irritation and other).

Stage of progression. Mechanisms of tumor progression.

Co-existence of tumor and organism. Influence of tumor on an organism. Mechanisms of cancer cachexia. Mechanisms of natural antioncological defence, immune and nonimmune mechanisms of resistancy. Mechanisms of tumors escape from immune supervision. Pathophysiological bases of prophylaxis and treatment of tumors.

### **Theme 9. Starvation. Hypoxia.**

Definition, types of fasting: physiological, pathological; complete, absolute, incomplete, partial. External and internal causes of starvation. Characteristics of basal metabolic disorders and metabolism in certain periods of complete starvation with water. The pathophysiological features of partial starvation. Types, etiology, pathogenesis of partial (qualitative) starvation.

Protein-energy deficiency, its forms: nutritional marasmus, kwashiorkor. Alimentary dystrophy. Factors affecting resistance to starvation.

The concept of therapeutic fasting.

Definition, classification principles of hypoxia. Mechanisms of hypoxia: a decrease in the supply and utilization of oxygen by cells abuse. The etiology of major types of hypoxia, hypoxic, respiratory, circulatory, blood, tissue mixed. Change of gas composition of arterial and venous blood in different types of hypoxia. Immediate and long-term adaptation mechanisms and adaptation to hypoxia. Resistance to hypoxia. Factors that sustain it. Mechanisms of hypoxic cell damage.

Modern principles of oxygen therapy. Iso- and hyperbaric oxygenation. The toxic effect of oxygen. Hyperoxia and free radical reactions. Hyperoxia as the cause of hypoxia.

### **Theme 10. Practical skills with the theme "Typical pathological processes."**

## Semantic module 2

### CONTENT MODULE 3.

#### Typical disorders in metabolism

##### Specific objectives:

- *Analyze disorders of energy metabolism in the body;*
- *Identify types and criteria for disorders of carbohydrate metabolism, explain their relationship to impaired energy metabolism;*
- *To analyze the role of regulation of carbohydrate metabolism disorders in the pathogenesis of failures;*
- *To explain WHO classification of diabetes mellitus and to characterize these types of diabetes;*
- *To explain the etiology of diabetes in the context of general ideas on the etiology of multifactorial disease: pathology analyze the relationship between heredity and environmental factors in the onset and development of diabetes 1st and 2nd types;*
- *Analyze metabolism in the pathogenesis of basic types (type 1, type 2) diabetes;*
- *Identify the nature of causal relationships and their role in the pathogenesis of basic types (type 1, type 2) diabetes and its complications;*
- *Identify criteria and infringements of protein, fat, water and electrolyte metabolism and acid-base status;*
- *To characterize the typical causes of fluid and electrolyte disorders, fat and protein metabolism and acid-base status;*
- *Analyze cause-and-effect relationships in the pathogenesis of common fluid and electrolyte disorders, fat and protein metabolism and acid-base status, while characterize the pathological changes and adaptive-compensatory;*
- *Analyze methods of experimental modeling of typical metabolic and energy on the causes and mechanisms of emergence and development.*

#### **Theme 11. Disorders of energy metabolism. Disorders of carbohydrate metabolism.**

The energy needs of the body. Negative and positive energy balance - causes and mechanisms of emergence and development. Basal metabolism as a factor of influence on energy balance. Pathological changes in basal metabolism: etiology and pathogenesis.

Disorders of energy in cells. Disorders of nutrients' transport across cell membranes, intracellular catabolic disorders. Disorders of cellular respiration, the effect of separation of oxidation and phosphorylation, its mechanisms. The role of disorders of energy metabolism in the life of cells, organs, body. The role of disorders of energy in cell damage.

Malabsorption of carbohydrates, the synthesis, cleavage and deposit of glycogen transport of carbohydrates in the cell. Disorders of the nervous and hormonal regulation of carbohydrate metabolism.

The syndrome of hypoglycemia: types, causes, mechanisms. Pathogenesis of hypoglycemic coma. The syndrome of hyperglycemia: types, causes and mechanisms of development.

Diabetes. Definition, classification (WHO). Experimental modeling of diabetes.

The etiology and pathogenesis of diabetes mellitus type 1. The role of genetic factors and environmental factors in its origin and development. Pathogenesis absolute insulin deficiency, its manifestations and consequences: disorders of energy, protein, carbohydrate, fat, water and electrolyte metabolism, acid-base status.

The etiology and pathogenesis of diabetes mellitus type 2. The role of genetic factors and

environmental factors in its origin and development. Variations of relative insulin deficiency in diabetes type 2 (secretory disorders in insulin resistant tissues). Manifestations and consequences of relative insulin deficiency. The concept of the metabolic syndrome.

Complications of diabetes. Coma: types, causes and mechanisms of development, manifestations, principles of therapy. Long-term complications (macro, microangiopathy, neuropathy, fetopathies etc.), Their general characteristics.

Preventing the emergence and development of diabetes. Principles of treatment of diabetes. Prevention of complications.

### **Theme 12. Disorders of fat metabolism. Disorders of protein metabolism.**

Disorders of digestion and absorption of lipids. Disorders of lipid transport in the blood. Hyper-, hypo-, dyslipoproteinemia. Dependence of dyslipoproteinemia from environmental factors (diet), heredity and related diseases. Modern classification dyslipoproteinemia (primary and secondary, LP phenotype, with high or low risk of atherosclerosis) criteria hypercholesterolemia, hypertriglyceridemia, low HDL.

The etiology and pathogenesis of primary (hereditary, family) and secondary (eating disorders, obesity, diabetes, kidney diseases, hypothyroidism, liver cirrhosis, AIDS, under the influence of drugs) dyslipoproteinemia. The effects / complications of dyslipoproteinemia. The principles and objectives of restoration of normal blood lipid composition.

The definition of obesity. Types of obesity. Experimental models. The etiology and pathogenesis of obesity. Mechanisms of fatty degeneration of liver.

Characteristics of medical problems associated with obesity.

Metabolic disorders purine and pyrimidine bases. Metabolism of vitamin.

The concept of positive and negative nitrogen balance. Disorders of the main stages of protein metabolism. Azotemia, productive and retention. Disorders of the blood protein, hyper-, hypo-, dysproteinemia. Disorders of function of transport of plasma proteins. Conformational changes of protein molecules disorders degradation of proteins in lysosomes and proteasomes and their role in disease.

Inherited metabolic acids.

Gout: etiology and pathogenesis. Hyper- and hypouricemia. Hereditary orotiduria.

Types of hypo- and hypervitaminosis, their etiology and pathogenesis. Mechanisms of major clinical manifestations. Principles of correction of vitamin A deficiency.

### **Theme 13. Disorders of water - salt metabolism. Disorders of acid - base status.**

Positive and negative water balance. Dehydration: extracellular and intracellular; hypo-, iso-, hyperosmolar. The causes and mechanisms of development. Protective and compensatory mechanisms.

Excessive water in the body. Hypo-, iso and hyperosmolar hyperhydria, causes and mechanisms of development, protective, compensatory responses. Extra- and intracellular hyperhydria.

The definition of "swelling", types of edema. The causes and mechanisms of edema. Starling theory of the pathogenesis of edema. Swelling caused by changes in oncotic pressure of the blood and tissue fluid. The role of vascular permeability disorders and outflow of lymph in the pathogenesis of edema. Swelling caused by a delay of sodium and / or water in the body. Mixedematous swelling. Principles of treatment of edema.

Hyper- and hyponatremia. The causes and mechanisms of development. Disorders caused by changes in the concentration of sodium ions in the extracellular fluid.

Hyper- and hypokalemia. The causes and mechanisms of development. The main manifestations of metabolic potassium ions.

Disorders of phosphorus-calcium metabolism. Hormonal regulation of phosphorus-calcium exchange: hyper- and hypoparathyroidism, hypo- and hypervitaminosis D, calcitonin secretion abuse. Rickets: causes and mechanisms of development, the main clinical manifestations. The principles of prevention and treatment of rickets. Forms of rickets resistant to vitamin D. The concept of osteodystrophy.

Hyper and hypo  $\text{Ca}^{2+}$  conditions, the causes and mechanisms of development. Calcification of soft tissue, metastatic, dystrophic and metabolic mechanisms. Hyper- and hypophosphatemia. Metabolic disorders of micronutrients. Etiology and pathogenesis.

General characteristics of disorders of acid-base status (CBS). Acidosis, definition, classification, basic laboratory criteria. Respiratory acidosis: causes and mechanisms of development, clinical manifestations. Nonrespiratory acidosis (metabolic, secretory, 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. Respiratory alkalosis (secretory, exogenous): causes and mechanisms of development. The role of blood buffer systems, ion exchange systems of respiratory and renal mechanisms of compensation and correction of CBS.

Pathological changes in the body in disorders of acid-base status. Principles of pathogenetic therapy of acidosis and alkalosis.

#### **Theme 14. Practical skills with the theme "Typical disorders in metabolism." Semantic module 3**

#### **Theme 15. FINAL MODULE CONTROL 1**

## Module 2. Pathophysiology of organs and systems.

### CONTENTS MODULE 4. Pathophysiology of the blood system. Changes in total blood volume. Erythrocytosis.

#### Exact aims:

- To determine typical disorders in the blood system, changes of general volume of blood, anaemia, erythrocytosis, leukopenia, hemoblastosis, leucosis, typical disorders of hemostasis; to point the criteria of the noted disorders.
- To apply existing principles for classification of typical disorders in the system of blood.
- To characterize causal factors, factors of risk, conditions of origin and development of typical disorders in the system of blood.
- To analyze causative-consequence relationships, to be able to explain pathological and adaptative-compensatory changes in pathogenesis of typical disorders in the system of blood.
- To apply knowledge of principles and classifications of anaemias for the analysis of their signs.
- To apply knowledge of reasons and pathogenesis of anaemias for their prophylaxis and treatment.
- To analyze the mechanisms of development and reasons of origin of disorders of cellular composition of "white" blood, be able to estimate their clinical consequences;
- To explain the features of tumor transformation of stem cells of bone marrow at acute and chronic leucosis.
- To analyze general laws of development of disorders of cellular composition of peripheral blood at acute and chronic leucoses.
- To estimate the role of genetic anomalies and anomalies of constitution in leucogenesis.
- To characterize the periods of risk in origin of leucoses ("peaks of leucoses") in children; to explain principles of diagnostics of leucoses.
- To analyze the features of etiology, pathogenesis and results of therapy of leucoses in children and adults.
- To estimate advantages of transplantation of bone marrow as the most effective method of treatment of leucoses.
- To determine the typical disorders in the system of hemostasis.
- To explain to reasons of origin and mechanisms of development of disorders of vessel-platelet chain of hemostasis.
- To analyze general laws of origin, development and completion of the states of hypo- and hypercoagulation.
- To explain the role disseminated blood coagulation, analyze reasons of origin and mechanisms of its development, characterize typical clinical signs depending on clinical course.

#### Theme 1. Pathophysiology of the blood system. Changes in total blood volume. Erythrocytosis.

Changes of general volume of blood. Characteristic of hypo- and hypervolemias, reasons and mechanisms of development.

Hemorrhage: etiology, pathogenesis. Pathological and adaptative-compensatory changes in pathogenesis of hemorrhage. Signs and consequences of hemorrhage (hypovolemia, anaemia, insufficiency of blood circulation/shock). Principles of therapy of hemorrhage. A concept about posthemotransfusion reactions and complications, mechanisms of their development and means of prophylaxis.

Erythrocytoses: determination of concept, types (absolute, relative; primary, second), etiology, pathogenesis.

Anaemias: determination of concept, clinical and haematological signs, principles of classification (according to etiology, pathogenesis, character of course, type of erythropoiesis, regenerative ability of bone marrow, color index, changes of sizes of red blood cells). Etiology, pathogenesis, haematological characteristic of posthemorrhagic anaemia (acute and chronic).

## **Theme 2. Pathophysiology of the blood system. Anemia.**

Etiologic classification (inherited, acquired) of hemolytic anaemias. Characteristic of causal factors of the acquired hemolytic anaemias. Ways of realization of genetic defects in pathogenesis of the inherited hemolytic anaemias (membrano-, enzymo-, hemoglobinopathias).

Hemolysis of red blood cells, intra- and extravascular as mechanisms of development of hemolytic anaemias. Characteristic clinical signs of hemolysis of red blood cells (icterus, hemoglobinuria, disseminating coagulation of blood, dyscholia, cholelythiasis, splenomegaly), their possible association with the type of hemolysis. Pathological forms of red blood cells, specific for the inherited hemolytic anaemias.

Classification of anaemias, related to disorders of erythropoiesis (defective, dysregulatory, hypo-, aplastic etc), general characteristic of reasons and mechanisms of development.

Etiology, pathogenesis, typical changes of peripheral blood, at iron deficient anaemias. A concept about iron refractory anaemias.

Anaemias, caused by insufficiency of vitamin B<sub>12</sub> and/or folic acid. Reasons of origin and mechanisms of development of absolute and relative deficit of vitamin of B<sub>12</sub> and folic acid. Malignant anaemia of Addison-Birmer. Characteristic of general disorders in organism at the deficit of vitamin B<sub>12</sub> and/or folic acid. Haematological picture of a vitamin B<sub>12</sub>-, folic acid deficient anaemias.

## **Theme 3. Morphological picture of blood at different types of anemia.**

Pathological, degenerative and regenerative forms of red erythrocytes.

Pathological forms of erythrocytes specific to hereditary hemolytic anaemias. Typical changes of peripheral blood at iron-deficient anaemias.

Hematological characteristic of B<sub>12</sub>-deficiency anaemias and/or folic acid deficit.

Peculiarities of diagnosis of different types of anaemias according to ability of regeneration of red bone marrow, color index.

## **Theme 4. Leukocytosis, leukopenia.**

Leucocytosis, principles of classification. Reasons and mechanisms of development of reactive leucocytosis. Neutrophilic, eosinophilic, basophilic, lympho- and monocytic leucocytosis. A concept of the nuclear shift of neutrophils, its varieties.

Leucopenia, principles of classification. Reasons, mechanisms of development of leucopenias, agranulocytosis (neutropenia). Pathogenesis of basic clinical signs.

Acquired and inherited disorders of structure and function of leucocytes. Leukemoid reactions.

## **Theme 5. Leukemia.**

Hemoblastoses, general characteristic of their basic groups. Leucoses as tumors. Principles of classification of leucoses (acute, chronic; myelo-, lympho-; primary, secondary).

Etiology of leucoses: characteristic of leucosogenic factors of physical, chemical, biological nature. Mechanisms of their transforming action on the stem cells of bone marrow. Anomalies of genotype and constitution as factors of risk of origin and development of leucoses. Children "peaks" of leucoses.

Typical laws and features of pathogenesis of acute and chronic leucoses: disorder of cellular composition of marrow and peripheral blood; morphological, cytogenetic, cytochemical, immunophenotypic characteristics; systemic disorders in the organism. Progression of leucoses, concept of "blastic crisis". Metastases of leucoses.

Principles of diagnostics and treatment of leucoses.

## **Theme 6. Disorders of the hemostasis system.**

General characteristic of typical disorders in the hemostatic system.

Hemorrhagic disorders in the hemostatic system. Insufficiency of vasculat-thrombocytic hemostasis. Angiopathies: types, reasons, mechanisms of development, pathogenesis of basic clinical signs. Thrombocytopenias: etiology, pathogenesis, mechanisms of disorders hemostasis. Trombocytopathias. Mechanisms of disorder of adhesion, aggregation of thrombocytes, elaborating of thrombocytic granules.

Disorder of coagulative hemostasis. Reasons of decline of activity of the system of blood coagulation and increase of activity of the anticoagulative and fibrinolytic systems. Basic signs of disorders of the separate stages of blood coagulation, their etiology and pathogenesis.

Trombophylic states: thrombosis, disseminated blood coagulation, localized intravessel blood coagulation. Principles of classification of disseminated blood coagulation (according to the course – acute, subacute, chronic; according to the starting mechanism of coagulation), etiology, pathogenesis. A role in pathology.

Principles of correction of disorders in the system of hemostasis.

## **Theme 7. Practical skills from a theme "Pathophysiology of blood". Semantic module 4.**

### **CONTENTS MODULE 5. Pathophysiology of circulatory system and external breathing**

#### **Exact aims:**

- *To determine typical pathological states and disorder in the systemic circulation: heart failure ; heart failure, arrhythmias of heart; arterial hypertension, arterial hypotension; arteriosclerosis, atherosclerosis.*
- *To analyze and apply existent classifications of typical disorders in the systemic circulation.*
- *To analyze the changes of basic parameters of cardio- and hemodynamics at insufficiency of heart (frequency and force of heart-contractions, minute and systolic volumes of blood, systolic, diastolic, mean and pulse arterial blood pressure, venous blood pressure).*
- *To analyze causative-consequence relationships, to be able to separate pathological and adaptive-compensatory changes, local and systematic processes in pathogenesis of insufficiency of blood circulation, heart failure, myocardial infarction, shock states (cardiogenic shock).*
- *To explain the mechanisms of development of arrhythmias.*
- *To apply knowledge about typical disorders of heart rhythm (disorders of automatism, excitability, conductivity and combined) for the analysis of electrocardiogram.*
- *To analyze the mechanisms of development of clinical signs of chronic heart failure and circulation of blood.*
- *To analyze the reasons and mechanisms of development of coronary heart disease, explain its possible consequences.*
- *To analyze disorders of basic functions of heart at acute coronary heart disease.*
- *To characterize the features of different forms of arteriosclerosis, explain the modern theories of pathogenesis of atherosclerosis.*
- *To apply modern criteria for diagnostics of arterial hypertension.*
- *To analyze classifications of arterial hypertension.*
- *To apply knowledge about the experimental modelling of second arterial hypertensions (kidney, endocrine, neurogenic) for the analysis of their pathogenesis.*
- *To interpret a primary arterial hypertension as multifactor disease.*
- *To differentiate the role of volume changes and peripheral resistance of blood flow in development of different haemodynamic variants of arterial hypertension.*
- *To analyze genetic defects as basis of pathogenesis of primary arterial hypertension.*
- *To explain the role of kidneys in pathogenesis of primary and secondary arterial hypertension.*
- *To apply knowledge about the experimental models of typical disorders in the system of blood circulation (coronary heart disease, arteriosclerosis, arterial hypertension) for the analysis of their pathogenesis.*
- *To explain reasons and mechanisms of development of arterial hypotension.*

- *To analyze reasons of origin and mechanisms of development of primary and secondary hypertension in the system of vessels of small circle of blood circulation.*
- *Determine the insufficiency of the external breathing through disorder of gas composition of blood.*
- *To analyze classifications, causes an pathogenesis of respiratory failure.*
- *To analyze the role of disorders of ventilation, diffusion of gases through an alveolo-capillary membrane, perfusion in the lung circulation in development of respiratory failure.*
- *To explain reasons and mechanisms of development of restrictive and obstructive disorders of alveolar ventilation.*
- *To explain the reasons of origin and pathogenesis of asphyxia.*
- *To analyze the mechanisms of development of different types of the periodic and terminal breathing.*
- *To make conclusion about character of disorders of ventilation of lungs (obstructive or restrictive) on the basis of analysis of results of pneumotachometry.*

### **Theme 8. Pathophysiology of external respiration. Respiratory failure.**

Determination of concept of failure of the external breathing, criteria, principles of classification. Extra pulmonary and pulmonary disorders of alveolar ventilation: central, neural-muscular, thoracodiaphragmatic, diminishing of communicating of airways, elastic properties of pulmonary tissue, amount of functioning alveoli. Mechanisms of disorder of alveolar ventilation: dysregulatory, restrictive, obstructive. Reasons and mechanisms of disorders of diffusion of gases in lungs.

Disorder of pulmonary circulation of blood. Disorder of general and regional ventilation-perfusion relations in lungs.

Disorders of non-respiratory functions of lungs, their influence on hemodynamics and hemostasis. Pathological breathing. Types of the periodic and terminal breathing.

Changes of indexes of gas composition of blood and acid-basic state at the different types of respiratory failure, their role for an organism.

Pathogenesis of basic clinical signs of failure of the external breathing. Shortness of breath: types, reasons, mechanisms of origin and development.

Asphyxia, reasons of origin and mechanisms of development.

### **Theme 9. Pathophysiology of the circulatory system. Circulatory insufficiency. Pathophysiology of the heart. Heart failure.**

Determination of concept of heart failure, principles of its classification, characteristic of disorders of cardio- and hemodynamics. A concept of acute and chronic ("stagnant", congestive) heart failure. Etiology, pathogenesis, stages of chronic heart failure. Mechanisms of development of basic clinical signs of chronic heart failure of blood (shortness of breath, cyanosis, edema).

Acute heart failure: etiology, pathogenesis, changes, pathological and adaptive-compensatory. Collapse, shock as variants of acute heart failure.

Determinations of concept of insufficiency of heart, principles of classification.

Heart failures a result of overload. Reasons of overload of heart by volume and by resistance. Mechanisms of immediate and long duration adaptation of heart to the surplus loading: tachycardia, hyperfunction (hetero-, homeometric), hypertrophy of myocardium. Hypertrophy of heart: types, reasons, mechanisms of development, stage (by Meerson). Features of the hypertrophied myocardium, reasons and mechanisms of its decompensation. Myocardial form of cardiac insufficiency.

Coronarogenic damages of myocardium. Insufficiency of coronary circulation (relative and absolute; acute and chronic), mechanisms of development. A concept of "critical stenosis". Consequences of ischemia of myocardium: depression of retractive activity, electric instability, damage/necrosis of cardiomyocytes, additional damage at reperfusion. Ischemic illness of heart as example of coronary heart disease, its varieties. Clinical-laboratory criteria, signs and complications of myocardial infarction. Pathogenesis of cardiogenic shock. Principles of prophylaxis and treatment of ischemic heart disease.

Etiology and pathogenesis of noncoronarogenic damages of myocardium, Cardiomyopathies. Classification. Characteristic of reasons and mechanisms of origin, clinical signs.

Extramyocardial insufficiency of heart. Disorders of pericardium. Acute tamponade of heart.  
Principles of cardioprotection and treatment of insufficiency of heart/ blood circulation.

### **Theme 10. Pathophysiology of blood vessels.**

A concept of vascular insufficiency. Types, reasons and mechanisms of its development.  
Arteriosclerosis: determination of concept, classification. Basic forms of arteriosclerosis:

atherosclerosis, mediocalcinosis, arteriolosclerosis, their general characteristics (typical localization, signs, complications).

Atherosclerosis. Factors of risk of atherosclerosis. Experimental models. Modern and historical theories of atherogenesis. A role of damage of endothelium, inflammation, inherited and acquired disorders of receptor-mediated transport of lipoproteins (LP) (disorder of receptors of LP, defects of molecules of LP, modification of LP) in atherogenesis. Disorders of transport of lipids in blood. Hyper-, hypo-, dyslipoproteinemias. Dependence of development of dyslipoproteinemias on the factors of environment (diet), heredity and concomitant diseases. Modern classifications of dyslipoproteinemias (primary and secondary; according to the phenotype of LP; with the high or low risk of atherosclerosis), criteria of hypercholesterolemia, hypertriglyceridemia, low level of LPHD.

Etiology, pathogenesis of primary (inherited, familial) and secondary (at disorders of feeding, obesity, diabetes mellitus, illnesses of kidneys, hypothyreosis, cirrhosis of liver, influence of medicinal drugs), dyslipoproteinemias. Consequences/complications of dyslipoproteinemias. Principles and aims of renewal of normal lipid composition of blood.

Arterial hypertension (AH), determination of concept, principles of classification. Hemodynamic variants of AH. A role of disorders of pressor and depressor systems in development of AH.

Primary and secondary arterial hypertension. Etiology, pathogenesis. Experimental models.

Primary AH as multifactor disease: a role of factors of heredity and external factors in development of primary AH. Theories of pathogenesis of primary AH (dysregulatory, membrane etc).

Mechanisms of development of primary and secondary hypertension of small circle of circulation of blood.

Arterial hypotension: determinations of concept, criteria. Etiology and pathogenesis of acute and chronic arterial hypotensions. Collapse. Reasons and mechanisms of development, signs.

### **Theme 11. Pathophysiological bases of heart rhythm disorders. Basics of ECG diagnosis.**

Arrhythmias of heart: classification, reasons, mechanisms, typical electrocardiographic signs. A role of additional conduction ways of heart in development of arrhythmias. Reasons and mechanisms of origin of ectopic foci of excitation in myocardium, mechanisms of the repeated entrance and recirculation of excitation. Fibrillation and defibrillation of heart.

Arrhythmias of heart: Disorders in conductive system of a heart. ECG signs of ischemic heart disease.

### **Theme 12. Practical skills with the theme "The pathophysiology of circulatory system and external breathing" Semantic module 5.**

#### **CONTENTS MODULE 6. Pathophysiology of digestion, liver, kidneys. Pathophysiology of the regulatory systems (endocrine, nervous) and extreme states**

##### **Exact aims:**

##### Pathophysiology of digestion

- *To determine typical pathological states in the system of digestion: insufficiency of digestion (maldigestion) and disorder of absorption (malabsorption).*
- *To apply different principles for classification of the most widespread nosological forms of pathology of digestive tract.*
- *To analyze ulcerous illness of stomach and/or duodenum as multifactor illness.*
- *To characterize the risk factors of origin of ulcerous illness of stomach and/or duodenum.*

- To apply the modern understanding of mechanisms of damage and protective possibilities of digestive tract for the analysis of pathogenesis of its ulcers.
- To estimate the role of experimental modelling of different forms of pathology of digestive channel for finding out of reasons and mechanisms of their origin and development.
- To apply knowledge about the role of the nervous and humoral regulation of different parts of digestive channel for the analysis of disorders of its motor, secretory and absorptive functions.
- To determine the criteria and types of disorders of protein, fatty, water-electrolyte metabolism and acid-basic state.
- To characterize reasons of typical disorders of water-electrolyte, fatty and protein metabolism and acid-basic state.
- To analyze the methods of experimental modelling of typical disorders of exchange of substances and energy for determining the reasons and mechanisms of their origin and development.
- To determine the indexes of secretory function and apply them for the analysis of its typical disorders.
- To analyze reasons of origin and mechanisms of development of pancreatitis.
- To analyze causative-consequence relationships, to be able to determine pathological and adaptive-compensatory changes, local and systemic in pathogenesis of pancreatic shock.
- To analyze the mechanisms of disorders of intestinal digestion, development of the states of maldigestion and malabsorption.
- To explain pathogenesis of clinical signs of malabsorption syndrome.
- To analyze clinical variants, reasons and mechanisms of development of intestinal ileus, explain its consequences and possible complications.

#### Pathophysiology of liver

- To characterize a concept, estimate criteria and apply them for classification of hepatic insufficiency, hepatic coma, icterus, portal hypertension.
- To analyze the different variants of hepatic insufficiency according to reasons and mechanisms of origin, course character, degree of severity.

#### Pathophysiology of kidneys

- To characterize reasons and mechanisms of development of chronic kidney failure (CKF).
- To analyze reactive changes of blood flow in kidneys at their impairment.
- To explain the metabolic disorders (metabolism of sodium and water, metabolism of potassium, acid-basic state, mineral metabolism, metabolism of xenobiotics/medications) and changes of endocrine function of kidneys at CKF.
- To estimate role of retentional nitrogenemia and other metabolic disorders in development of poliorganic insufficiency.
- To explain general principles of prophylaxis and treatment of acute and chronic renal failure

#### Pathophysiology of regulatory systems and extreme states

- To apply the general understanding of endocrine function for characteristic of typical disorders of endocrine glands functions.
- To explain the reasons and general mechanisms of development of primary and secondary endocrinopathies.
- To characterize neuroendocrine pathology according to the reasons and mechanisms of its development.
- To analyze the consequences of disorders of secretion of hormones by adenohypophysis.
- To analyze the consequences of disorders of secretion of hormones by neurohypophysis.
- To explain reasons of primary and secondary hyper- and hypofunction of adrenal glands cortex.
- To analyze pathogenesis of disorders of metabolism and physiology functions at hyper- and hypofunction of adrenal glands.
- To explain the mechanisms of development of the hereditary disorders of function of adrenal glands. To explain the reasons, mechanisms of development and signs of hyper- and hypofunction

*of thyroid gland. To analyze the disorder of energetic metabolism in an organism.*

- To determine a concept "goiter", to analyze the types of goiter according to etiology, pathogenesis and functional state of thyroid gland.*
- To analyze the reasons and typical disorders in an organism at hyper- and hypofunction of parathyroid glands.*
- To analyze the disorder of metabolism in pathogenesis of basic types (type 1, type 2) of diabetes mellitus.*
- To determine the character of cause –effect relations and their role in pathogenesis of basic types (type 1, type 2) of diabetes mellitus and its complications.*
- To analyze the reasons and mechanisms of disorders of function of the reproductive system.*
- To explain the typical disorders at insufficiency of sexual glands in men and women.*
- To explain the biological role of stress, the reasons and mechanisms of its development, to know about "illnesses of adaptation".*
- To analyze the general principles of diagnostics and treatment of disorders of endocrine glands function.*
- To determine the typical disorders of the nervous system functions.*
- To apply the different principles for classification/characteristic of disorders of activity of the nervous system.*
- To explain the features of typical pathological processes at their localization in a central nervous system.*
- To apply the knowledge about reasons and mechanisms of disorders of sensor functions of the nervous system in development of somatovisceral pathology.*
- To analyze the types of pain, know about modern theories of pain pathogenesis.*
- To analyze signs, reasons, mechanisms of development of disorders of motion function of the nervous system.*
- To know reasons and mechanisms of development of disorders of activity of the autonomous nervous system.*
- To apply the knowledge about reasons and mechanisms of disorders of a trophic function of the nervous system for the analysis of pathogenesis of neurogenic dystrophies.*
- To apply the knowledge about reasons and mechanisms of damage of cells for the analysis of structural and functional disorders of neurons and their consequences.*
- To analyze the role of acute and chronic disorders of cerebral circulation of blood in disorders of activity of brain and organism on the whole.*
- To estimate the role of ageing changes in disorders of functioning of the nervous system.*
- To explain the character of disorders of the nervous system, caused by genetic defects.*
- To explain the mechanisms of development and basic signs of disorders of integrative functions of CNS on the basis of knowledge about general laws of its functioning.*
- To determine a concept the "extreme states", shock/collapse, coma.*
- To explain the principles of classification of the shock and comatose states.*
- To analyze the reasons and mechanisms of development of the extreme states.*
- To explain the principles of therapy of the extreme states.*

### **Theme 13. Pathophysiology of the digestive system. Insufficiency of digestion.**

General information of insufficiency of digestion, principles of classification. Reasons of insufficiency of digestion (maldigestion). Role of alimentary and infectious agents, disorders of the nervous and humoral regulation of functioning of the digestive system. Connection of disorders of digestion with disorders of metabolism and energetic balance in an organism.

Disorders of appetite. Anorexia. Types of starvation: physiological, pathological; complete, absolute, incomplete, partial. External and internal reasons of starvation. Characteristic of disorders of basic metabolism in certain periods of complete starvation with water. Pathophysiology features of incomplete starvation. Types, etiology, pathogenesis of partial (quality) starvation. Protein-calorie insufficiency, its forms: alimentary marasmus, kwashiorkor. Allimentary dystrophy.

Factors which influence on resistance of organism to starvation. A concept of medical starvation.

Reasons and mechanisms of disorder of digestion in the oral cavity. Etiology, pathogenesis, experimental models of caries and parodontosis. Reasons, mechanisms and consequences of disorders of saline excretion.

Disorder of motor function of esophagus. Etiology, pathogenesis of heartburn.

Disorders of digestion in a stomach. General characteristic of disorders of motor and secretory functions of stomach. Pathological gastric secretion, types; reasons and mechanisms of development.

Etiology, pathogenesis of ulcerous illness of stomach and/or duodenum. Role of *Helicobacter pilory*. Etiology and pathogenesis of symptomatic ulcers of stomach and/or duodenum.

Disorder of digestion in bowels, etiology, pathogenesis. Disorders of digestion, related to insufficiency of secretion of pancreatic juice. Etiology, pathogenesis, complications of acute and chronic pancreatitis. Pathogenesis of pancreatic shock.

Intestinal dyskinesias. Reasons, mechanisms and signs of constipation and diarrhea. Intestinal ileus: types, etiology, pathogenesis.

Disorder of barrier function of bowels: intestinal autointoxication, coli-sepsis, dysbacteriosis.

Syndrome of malabsorption: determination of concept, signs (diarrhea, diminishing of weight of body, protein insufficiency, hypovitaminoses), reasons and mechanisms of development. Intestinal enzymopathies.

#### **Theme 14. Pathophysiology of the liver. Hepatic insufficiency.**

Liver failure: determinations of concept, principles of classification. Etiology, pathogenesis, experimental models of hepatic insufficiency. Typical disorders of carbohydrate, protein, lipid, water-electrolyte metabolism, metabolism of microelements, vitamins and hormones, disorder of activity of the functional systems of organism at insufficiency of liver.

Insufficiency of antitoxic function of liver, mechanisms of basic signs. Types, reasons, pathogenesis of hepatic coma. Role of cerebrotoxic substances.

Insufficiency of excretory function of liver, basic signs. Determination of concept, criteria, types of jaundice, reasons and mechanisms. Comparative characteristic of disorders of pigment metabolism at hemolytic, hepatic and mechanical jaundices; syndromes of cholemiias and hypo-, acholias. Gall-stone illness.

Syndrome of portal hypertension: etiology, pathogenesis, signs. Mechanisms of development of hydroperitoneum, hepato-lienal and hepato-renal syndromes.

Disorder of protein metabolism. Disorder of metabolism of purine and pirimidine bases. Positive and negative nitrous balance. Disorder of the basic stages of protein metabolism . Nitrogenemia, productive and retentional. Disorder of protein composition of blood: hyper-, hypo-, dysproteinemia. Disorder of a transport function of plasma proteins. Conformational changes of protein molecules, disorder of degradation of proteins in lysosomes and proteosomes, their role in pathology. Inherited disorders of metabolism of aminoacids

#### **Theme 15. Pathophysiology of the kidneys.**

A concept about renal failure, principles of classification. Prerenal, renal and postrenal mechanisms of disorders of kidney processes. Reasons and mechanisms of disorders of circulation of blood in kidneys. Functional, physical and chemical bases of disorders of glomerular filtration. Reasons and mechanisms of disorders of canalicular reabsorption and secretion. Inherited tubulopathies. Basic indexes of kidney function. The use of functional tests for estimation of disorder type of kidney functions.

General signs of insufficiency of kidney functions. Reasons, signs and mechanisms of development of retentional nitrogenemia. Pathogenesis of kidneys edemas. Disorder of the acid-basic state: kidney nitrogenemic acidosis, proximal and distal canalicular acidosis. Pathogenesis and signs of kidney osteodystrophy. Mechanisms of development of arterial hypertension, anaemia, disorders of hemostasis at kidney diseases.

Glomerulonephritis: determination of concept, principles of classification. Experimental models,

etiology and pathogenesis of diffuse glomerulonephritis. Nephritic syndrome, primary and secondary. Reasons and mechanisms of formation of kidney stones, urolithiasis. Pielonephritis.

Quantitative and qualitative changes of composition of urine. Oliguria, anuria and poliuria. Water, osmotic and hypertensive diuresis. Hypo- and isosthenuria. Pathological components of urine: proteinuria, cylindruria, glucosuria, aminoaciduria, hematuria, leucocyteuria. A concept of selective and nonselective proteinuria and their mechanisms.

Syndromes of acute and chronic renal failure: criteria, reasons and mechanisms of development, clinical signs. Pathogenesis of uremic coma. Principles of therapy of kidney insufficiency. Concept about extracorporeal and peritoneal hemodialysis, lymphodialysis, limphosorbition.

### **Theme 16. Pathophysiology of the endocrine system. General characteristics of disorders of the hypothalamus, pituitary, thyroid gland.**

General characteristic of disorders of activity of the endocrine system: hypofunction, hyperfunction, dysfunction of glands; primary, secondary endocrinopathies. Reasons of origin and mechanisms of development of endocrinopathies. Dysregulatory endocrinopathies: disorder of nervous, neuroendocrine, endocrine and metabolic regulation of glands functions. Disorders of direct and feedback regulatory ties.

Glandular endocrinopathies: reasons and mechanisms of disorders of synthesis, depositing and secretion of hormones.

Peripheral disorders of endocrine function. Disorder of transport and metabolic inactivation of hormones. Disorders of reception of hormones, mechanisms of desensitization and hormonal resistance (prereceptor, receptor, postreceptor).

Pathology of the hypothalamo-pituitary system. Reasons of origin and mechanisms of development of syndromes caused by surplus or lack of pituitary hormones. General characteristic of disorders of activity of hypothalamo-pituitary-thyroid, hypothalamo-pituitary-adrenal, hypothalamo-pituitary-gonade systems. Etiology, pathogenesis, clinical signs of panhypopituitarism. Reasons, mechanisms, clinical signs of partial insufficiency of hormones of adenohipophysis (STH, TTH, ACTH, gonadotropines). Etiology, pathogenesis, clinical signs of the states of partial hyperfunction of adenohipophysis (STH, TTH, ACTH, gonadotropines, prolactine).

Pathophysiology of disorders of endocrine function of pancreas. Diabetes mellitus. Determination of concept, classification (by WHO). Experimental modelling of diabetes mellitus. Etiology, pathogenesis of diabetes mellitus of 1st type. A role of the inherited factors and factors of environment in its origin and development. Pathogenesis of absolute insulin insufficiency, its signs and consequences: disorder of energetic, protein, carbohydrate, fatty, water-electrolyte metabolisms, acid-basic state. Etiology, pathogenesis of diabetes mellitus of 2nd type. A role of the inherited factors and factors of environment in its origin and development. Variants of relative insulin insufficiency at diabetes of 2nd type (secretory disorders of B-cells, resistance of tissues-targets to insulin). Signs and consequences of relative insulin insufficiency. Coma: varieties, reasons and mechanisms of development, signs, principles of therapy. Complications (microangiopathies, neuropathies, fetopathies etc), their general characteristic. Prophylaxis of diabetes mellitus. Principles of therapy of diabetes mellitus. Prophylaxis of complications.

Pathophysiology of neurohypophysis. Diabetes insipidus: reasons and mechanisms of development, clinical signs.

Pathology of thyroid gland. Hypothyroidism: reasons and mechanisms of development, pathogenesis of basic disorders in an organism. Hyperthyroidism: reasons and mechanisms of development, pathogenesis of basic disorders in an organism. Goiter: types (endemic, sporadic, nodal and diffuse toxic), their etiology and pathogenesis; characteristic of disorders of the functional state of gland.

Disorder of function of parathyroid glands: types, reasons, mechanisms of development, clinical and pathophysiological signs.

### **Theme 17. Pathophysiology of endocrine disorders in pathology of the adrenal glands and sex glands.**

Disorder of function of sexual glands: primary and secondary hyper- and hypogonadism . Reasons

and mechanisms of development, extragenital signs of disorders of function of sexual glands.

Pathology of epiphysis: hypo- and hyperfunction, basic signs.

Principles of diagnostics and methods of treatment of pathology of endocrine glands.

Pathology of adrenal glands. Insufficiency of adrenal cortex: types (primary, secondary; acute, chronic), etiology, pathogenesis, clinical signs. Hyperfunction of adrenal cortex: types (primary, secondary), etiology, pathogenesis, clinical signs. Syndromes of Itsenko-Kushing, Kon, innate hyperplasia of adrenal cortex(adrenogenital syndrome). Types, reasons, mechanisms of development, clinical signs of disorders of activity of cerebral substance of adrenal glands.

A concept of stress as heterospecific, stereotype adaptative reaction of organism on the action of extraordinary irritants. Stages of development of general adaptation syndrome. Mechanisms of a long-term adaptation. A concept of a stressor damage and "illnesses of adaptation". Principles of prevention of stressor damages.

### **Theme 18. Pathophysiology of extreme conditions and nervous system.**

General characteristic of pathology of the nervous system, principles of classification of disorders of its activity. Features of development of typical pathological processes in the nervous system.

Disorder of sensory functions of the nervous system. Disorders of mechano-, thermo-, proprio- and nociception. Disorder of conduction of sensory information. Syndrome of Brown-Sekar. Signs of damage of thalamic centers and sensory structures of cerebral cortex.

Pain. Pain peculiarities as a type of sensitivity. Principles of classification of pain. Somatic pain. Visceral pain. Etiology and pathogenesis of pain: theory of division of impulses ("theory of gate"), theory of specificity. Pathological pain: neuralgia, causalgia, phantomic, thalamic . Peripheral, peripheral-central and central mechanisms of development of pathological pain. Emotional, vegetative, motional reactions of organism on pain. Emotional-pain stress, pain shock. Natural antinociceptive mechanisms. Principles and methods of antipain therapy.

Disorder of motional function of the nervous system. Experimental modelling of motional disorders. Peripheral and central paralyses and pareses:reasons, mechanisms of development, basic signs. Spinal shock. Motional disorders of subcortical origin. Disorders, related to the impairment of cerebellum. Cramps, their types. Disorder of neuro-muscular transmission.

Myastheny.

Disorders of vegetative functions of the nervous system, methods of experimental modelling. Syndrome of vegetovascular dystony.

Disorder of trophic function of the nervous system. Neurogenic dystrophy. Etiology, pathogenesis.

Disorder of integrative functions of CNS. Reasons and mechanisms of disorders of electrophysiological processes in neurons. Disorder of activity of the ionic channels. Reasons and mechanisms of disorders of neurochemical processes. Disorder of metabolism of neurotransmitters, neuromodulators, neurohormones. Pathological excitation and pathological slowing down of nerval centres. Neuroses.

Damage of neurons as one of reasons of disorders of integrative functions of CNS.

Acute and chronic disorders of cerebral circulation of blood. Stroke. Edema and swelling of cerebrum, reasons and mechanisms of development. Intracranial hypertension. A role of damages of neuroglia in development of pathological processes in CNS. Damage of hematoencephalic barrier and autoimmune impairment of cerebrum.

The etiology and pathogenesis of anxiety disorders, depression, schizophrenia.

A concept of the extreme states.

Shock: types, clinical signs, reasons and mechanisms of development. Disorder of general hemodynamics and microcirculation in pathogenesis of the shock states. Stages of shock. A role of hormones and physiological active substances and products of damaged tissues in pathogenesis of the shock states. Concept about „shock organs". Participating of neuromechanisms in development of shock. Pathophysiological bases of prophylaxis and therapy of shock.

A concept of crush-syndrome. Reasons, mechanisms of development, signs.

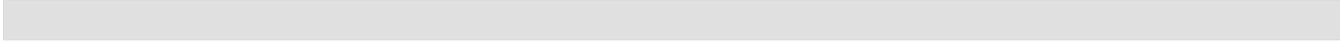
Collapse. General and different signs of shock and collapse. Reasons and mechanisms of development of the collaptoid states.

Coma. Principles of classification. Reasons and mechanisms of development of the comatose

states. A role of disorders of energetic supply of cerebrum, osmotic disorders, ionic and acid-basic homoeostasis in pathogenesis of coma. Principles of therapy of coma.

**Theme 19. Practical skills from a theme "Pathophysiology of digestion, liver, kidneys, regulatory systems and extreme states" Semantic module 6**

**Theme 20. FINAL MODULE**



## 6.2 STRUCTURE OF DISCIPLINE

Topic's and semantic module's names	Total number of hours			
	Form of education: full-time			
	Totally	including		
Lectures		Practical classes	Self-education	
1 <sup>st</sup> semester				
<b>MODULE 1. General pathology</b>				
<i><b>CONTENT MODULE 1 General nosology as a general study about illness, etiology and pathogenesis. Pathogenic action of factors of external environment. A role of internal factors in pathology</b></i>				
<b>Theme 1.</b> Subject and methods of pathophysiology. Methods of the pathophysiological resources. Development of pathophysiology. Study about illness, etiology and pathogenesis.	6	2	2	2
<b>Theme 2.</b> Pathogenic action of physical, chemical and biological factors	5	1	2	2
<b>Theme 3.</b> Role of heredity and constitution in pathology.	5	1	2	2
<b>Theme 4.</b> Pathology of reactivity. Allergy.	8	2	2	4
<b>Theme 5.</b> Semantic module 1 “General nosology”	4		2	2
<b>Totally for semantic module 1</b>	<b>28</b>	<b>6</b>	<b>10</b>	<b>12</b>
<i><b>CONTENT MODULE 2. Typical pathological process</b></i>				
<b>Theme 6.</b> Pathophysiology of cell. Cell damage. Typical disorders of microcirculation.	5	1	2	2
<b>Theme 7.</b> Inflammation.	6	2	2	2
<b>Theme 8.</b> Fever. Neoplasia. Tumors.	6	2	2	2
<b>Theme 9.</b> Starvation. Hypoxia.	5	1	2	2
<b>Theme 10.</b> Semantic module 2 “typical pathological process”	4		2	2
<b>Totally for semantic module 2</b>	<b>28</b>	<b>6</b>	<b>10</b>	<b>10</b>
<i><b>CONTENT MODULE 3. Typical disorders of metabolism</b></i>				
<b>Theme 11.</b> Disorders of energetic metabolism. Disorders of carbohydrate metabolism. Diabetes mellitus.	8	2	2	4
<b>Theme 12.</b> Disorders of lipid and protein metabolism. Disorders of vitamin's metabolism.	6	2	2	2
<b>Theme 13.</b> Disorders of water-electrolytic and acid-base metabolism.	10	4	4	2
<b>Theme 14.</b> Semantic module 3 “Typical disorders of metabolism”	4		2	2
<b>Totally for semantic module 3</b>	<b>28</b>	<b>8</b>	<b>10</b>	<b>12</b>
<b>Theme 15. MODULE 1</b>	8		2	6
<b>Totally for Module 1</b>	<b>90</b>	<b>20</b>	<b>30</b>	<b>40</b>
2 <sup>nd</sup> semester				
<b>MODULE 2. Pathophysiology of organs and systems</b>				
<i><b>CONTENT MODULE 4. Pathophysiology of the blood system</b></i>				
<b>Theme 1.</b> Pathophysiology of the blood system.	6	2	2	2

Erythrocytoses. Anaemias, caused by hemorrhage.				
<b>Theme 2.</b> Hemolytic anaemias and anaemias, caused by disorders of erythropoiesis.	6	1	2	3
<b>Theme 3.</b> Morphological picture of blood at different types of anaemias.	5		2	3
<b>Theme 4.</b> Leucocytoses, leucopenias.	5	1	2	2
<b>Theme 5.</b> Leucoses.	5	1	2	2
<b>Theme 6.</b> Disorder of the hemostatic system.	5	1	2	2
<b>Theme 7.</b> Semantic module 4 "Pathology of blood".	6		2	4
<b>Totally for semantic module 4</b>	<b>38</b>	<b>6</b>	<b>14</b>	<b>18</b>
<b><i>CONTENT MODULE 5. Pathophysiology of circulation and respiratory system</i></b>				
<b>Theme 8.</b> Pathophysiology of the external breathing. Respiratory failure.	6	2	2	2
<b>Theme 9.</b> Pathophysiology of systemic circulation. Pathophysiology of heart. Insufficiency of heart. Coronary heart disease.	5	1	2	2
<b>Theme 10.</b> Pathophysiology of blood vessels.	5	1	2	2
<b>Theme 11.</b> Heart arrhythmias. Pathophysiologic basics of ECG analysis.	7	1	2	4
<b>Theme 12.</b> Semantic module 5. "The pathophysiology of circulatory system and external breathing"	6		2	4
<b>Totally for semantic module 5</b>	<b>29</b>	<b>5</b>	<b>10</b>	<b>14</b>
<b><i>CONTENT MODULE 6. Pathophysiology of digestion, liver, kidneys. Pathophysiology of the regulatory systems (endocrine, nervous) and extreme states</i></b>				
<b>Theme 13.</b> Pathophysiology of the digestive system. Insufficiency of digestion.	6	2	2	2
<b>Theme 14.</b> Pathophysiology of liver. Liver failure.	8	2	2	4
<b>Theme 15.</b> Pathophysiology of kidneys. Renal failure. Basics of interpretation of urine analyzes.	6	2	2	2
<b>Theme 16.</b> Pathophysiology of the endocrine system. General characteristic of disorders of activity of the endocrine system. Pathology of the hypothalamo-pituitary system. Pathology of thyroid, parathyroid glands.	6	1	2	3
<b>Theme 17.</b> Pathophysiology of the endocrine system. Pathology of adrenal glands. Stress.	6	1	2	3
<b>Theme 18.</b> Pathophysiology of the nervous system. Pathophysiology of the extreme states.	7	1	2	4
<b>Theme 19.</b> Semantic module 6 "Pathophysiology of digestion, liver, kidneys, regulatory systems and extreme states".	6	9	2	4
<b>Totally for semantic module 6</b>	<b>45</b>	<b>20</b>	<b>14</b>	<b>22</b>
<b>Theme 20.</b> Module 2	8		2	6
<b>Totally for Module 2</b>	<b>120</b>	<b>20</b>	<b>40</b>	<b>60</b>
<b>Toatally for year</b>	<b>210</b>	<b>40</b>	<b>70</b>	<b>100</b>

### 6.3 THEMATIC PLAN OF CLASSES

#### Module 1

№	Themes of practical classes	Hours
1.	Subject and methods of pathophysiology.	2
2.	Pathogenic influence of environment on the organism.	2
3.	The role of heredity and constitution in pathology.	2
4.	The pathology of reactivity. Immunological reactivity disorders. Immunodeficiency. Allergy.	2
5.	<b>Practical skills from a theme "General nosology". Semantic module 1.</b>	2
6.	Cell damage. Disorders of the peripheral circulation and microcirculation.	2
7.	Inflammation.	2
8.	Fever. Neoplasia. Tumors.	2
9.	Starvation. Hypoxia.	2
10.	<b>Practical skills from a theme "Typical pathological process". Semantic module 2.</b>	2
11.	Disorders of energetic metabolism. Carbohydrate metabolism disorders. Diabetes mellitus.	2
12.	Lipid and protein metabolism disorders.	2
13.	Water and electrolytic metabolism disorders. Microelements exchange disorders. Acid-base balance disorders.	2
14.	<b>Practical skills from a theme "Disorders of metabolism". Semantic module 3.</b>	2
15.	<b>Final module 1</b>	2
	<b>Totally</b>	<b>30</b>

#### Module 2

№	Themes of practical classes	Hours
1.	Pathophysiology of the blood system. Erythrocytoses. Anemias, caused by hemorrhage.	2
2.	Hemolytic anemias and anemias, caused by disorders of erythropoiesis.	2
3.	Morphological picture of blood at different types of anaemias.	2
4.	Leucocytoses, leucopenias.	2
5.	Leucoses.	2
6.	Disorder of the hemostatic system.	2
7.	<b>Practical skills from a theme "Pathology of blood". Semantic module 4.</b>	2
8.	Pathophysiology of the external breathing. Respiratory failure.	2
9.	Pathophysiology of systemic circulation. Pathophysiology of heart. Insufficiency of heart. Coronary heart disease.	2
10.	Pathophysiology of blood vessels.	2
11.	Heart arrhythmias. Pathophysiologic basics of ECG analysis.	2
12.	<b>Practical skills with the theme "The pathophysiology of circulatory system and external breathing" Semantic module 5.</b>	2
13.	Pathophysiology of the digestive system. Insufficiency of digestion.	2
14.	Pathophysiology of liver. Liver failure.	2

15.	Pathophysiology of kidneys. Renal failure. Basics of interpretation of urine analyzes.	2
16.	Pathophysiology of the endocrine system. General characteristic of disorders of activity of the endocrine system. Pathology of the hypothalamo-pituitary system. Pathology of thyroid, parathyroid glands.	2
17.	Pathophysiology of the endocrine system. Pathology of adrenal glands. Stress. Pathophysiology of sex glands.	2
18.	Pathophysiology of the nervous system. Pathophysiology of the extreme states.	2
19.	<b>Practical skills from a theme "Pathophysiology of digestion, liver, kidneys, endocrine and nervous systems, extreme states". Semantic module 6.</b>	2
20.	<b>Final module 2</b>	2
	<b>Totally</b>	40

#### 6.4. INDIVIDUAL WORK

##### Module 1

№	Name of topic	Number of hours	Types of control
1.	<b>Preparation for practical classes - theoretical training and development of practical skills.</b>	25	Current control in laboratory classes
2.	<b>Independent elaboration of topics that are not included in the lesson plan:</b>		
2.1	Pathogenic effect of electric current. Influence of space flight factors on the body.	1	Final module control
2.2	Chemical pathogenic factors. Intoxication. Natural mechanisms of protection against toxins and poisons.	1	
	Disruption of cell energy supply. Disorders of cellular respiration. The role of energy metabolism disorders in cell life / damage.	1	
3.	Preparation for semantic module control	6	
4.	<i>Preparation for the final modular control</i>	6	
	<b>TOTALLY</b>	<b>40</b>	

##### Module 2

№	Name of topic	Number of hours	Types of control
1.	<b>Preparation for practical classes - theoretical training and development of practical skills.</b>	40	Current control in laboratory classes
2.	<b>Independent elaboration of topics that are not included in the lesson plan:</b>		
2.1	Pathophysiology of nervous system	2	Final module control
3.	Preparation for semantic module control	12	
4.	<i>Preparation for the final modular control</i>	6	
	<b>TOTALLY</b>	<b>60</b>	

## 7. TOOLS, EQUIPMENT AND SOFTWARE USED BY THE COURSE

Technical means: curves for analysis (spiograms, cardiograms), CBC, urine analyses, biochemical analyses, schemes, situational problems. Textbooks, textbooks, study tables, multimedia lectures, texts and lecture notes. A set of tables for all sections of pathological physiology Methodological developments for students in practical classes. Collection of test tasks. Electronic bank of test tasks, bank of test tasks on paper, situational tasks.

Software: X-TLF open licensing computer software.

### Recommended Literature

#### Basic

1. Krishtal N.V. Pathophysiology: textbook// N. Krishtal, V. Mikhnev// Kyiv: AUS Medicine Publishing, 2017. – 656 p.
2. Simeonova N.K. Pathophysiology/ N.Simeonova// Kyiv, Ukraine. – 2010. – 544p.
3. Victor N. Jelski, Svetlana V. Kolesnikova. Handbook Of Pathophysiology Part 1: General Pathophysiology. - Donetsk, Ukraine. – 2009. – 152 p.
4. Victor N. Jelski, Svetlana V. Kolesnikova. Handbook Of Pathophysiology Part 2: Pathophysiology of organs and systems. - Donetsk, Ukraine. – 2011. – 172 p.
5. Lecture Notes For Health Science Students. General Pathology// Mesele Bezabeh, Abiye Tesfaye, Bahiru Ergicho, Mengistu Erke, Seyoum Mengistu, Alemayehu Bedane, Abiyot Desta/ Jimma University, Gondar University Haramaya University, Dedub University. – 2004. – 252 p.

#### Additional

1. Porth, Carol. Essentials of pathophysiology: concepts of altered health states /Carol Mattson Porth ; consultants, Kathryn J. Gaspard, Kim A. Noble. —3rd ed. 2011 Wolters Kluwer Health | Lippincott Williams & Wilkins. – 2011. – 1282 p.
2. Robbins Pathology basis of disease / Cotran R.S., Kumar V., Robbins S.L. - 2000.

### Information Resources

1. e-learn.uzhnu.edu.ua – Pathophysiology resources for Uzhgorod National University students
2. [https://www.youtube.com/channel/UCpcfR2oVUy4jSeYPs\\_WHALw/videos](https://www.youtube.com/channel/UCpcfR2oVUy4jSeYPs_WHALw/videos)
3. Science.gov: Diseases and Medical Conditions [http://www.science.gov/browse/w\\_127D.htm](http://www.science.gov/browse/w_127D.htm)
4. Science.gov: Diseases and Medical Conditions is a government science gateway. This section provides information about diseases and medical contitions.
5. Hardin M. D. <http://hardinmd.lib.uiowa.edu/>
6. Maintained by Hardin Library at the University of Iowa, provides links to qualtiy health and medical information sites
7. Introduction to Human Disease: Web Links <http://health.jbpub.com/humandisease/8e/>
8. Selected web links correlated to the chapters of Introduction to Human Disease, 7th ed..
9. Museum of Human Disease <http://www.med.unsw.edu.au/pathology/pathmus/>
10. WebPath <http://www-medlib.med.utah.edu/WebPath/webpath.html>

**Viewing results  
working program of the discipline**

The work program was re-approved on 20\_\_ / 20\_\_ academic year. unchanged; with changes (emphasis added) (Appendix \_\_).

protocol № \_\_ from " \_\_ " \_\_\_\_\_ 20 \_\_ Head of the department \_\_\_\_\_  
(signature) (Surname initials)

The work program was re-approved on 20\_\_ / 20\_\_ academic year. unchanged; with changes (emphasis added) (Appendix \_\_).

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(signature) (Surname initials)

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