

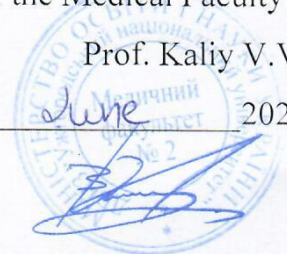
MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE  
STATE UNIVERSITY  
“UZHHOROD NATIONAL UNIVERSITY”  
MEDICAL FACULTY № 2  
DEPARTMENT OF FUNDAMENTAL MEDICAL DISCIPLINES

“APPROVED”

Dean of the Medical Faculty 2

Prof. Kaliy V.V.

“29” June 2021



THE WORKING PROGRAM OF THE EDUCATIONAL DISCIPLINE  
PHYSIOLOGY

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

The physiology working program for international students with English language of studying, the studying direction 22 "Health Care", specialty 222 "Medicine"

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The 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 subject

Name of indicators	Distribution of hours according to the study plan	
	Full-time education	External form of education
Number of ECTS credits – 10	<b>Year of studying:</b>	
Total number of hours – 300 Submodules – 6	2 – nd	
Number of modules – 2	<b>Semester</b>	
Weekly hours for full-time education: laboratory – 4,5 individual student`s work – 3	2 – nd	3 – nd
	<b>Lectures</b>	
	20 hours	30 hours
	<b>Practical</b>	
	-	-
Type of final control: exam	<b>Laboratory classes</b>	
	70 hours	70 hours
Form of final control: written	<b>Individual work</b>	
	60 hours	50 hours

## 2. THE AIM OF THE EDUCATIONAL DISCIPLINE

Ultimate goals for students who have finished educational discipline “Physiology” are using of this knowledge as a theoretical basis of future profession. The treatment of disease is nothing more than a correction of the natural mechanisms of regulation with drugs and non-drug methods.

### To know:

- functions of organs and systems and main physiological processes that are underlying these functions;
- mechanisms of the functions regulations that are aimed to:
  - a) adaptive reactions of the organism
  - b) maintaining homeostasis
- normal ranges of the homeostasis parameters

### To be able:

To evaluate the experiment parameters of the functions of the healthy human systems using analyse of:

- sphygmography, phonocardiography, electrocardiography;
- Blood samples;
- Functional samples (with standart physical loading, ortostatic, with maximum breath holding, direct thermometry);

To draw and explain schems of:

- Membrane potentials;

Regulation circle..

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 6. Ability to make informed decisions.

GC 11. Information and communication technology usage skills.

GC 12. Definition and persistence of tasks and responsibilities.

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

PC 4. Ability to determine the principles and nature of disease treatment

PC 6. Ability to conduct evacuation activities.

PC 7. Ability to determine the tactics of emergency medical care

PC 11. Ability to determine therapeutic nutrition in the treatment of diseases

PC 12. Ability to determine the tactics of physiological childbirth and the postpartum period

PC 19. Ability to process state, social, economic and medical information

## 3. PREREQUISITES FOR STUDY DISCIPLINE

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

Code 8 OK for EP “Medical Biology”

Code 9 OK for EP “Medial and Biological Physics”

Code 10 OK OK for EP “Medical Chemistry”

#### 4. EXPECTED LEARNING RESULTS

In accordance with the educational program "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 information on the diagnosis, using a standard procedure based on the results of laboratory and instrumental studies.	PRS 2
Highlight the leading clinical symptom or syndrome. Establish the most probable or syndromic diagnosis of the disease. Assign laboratory and / or instrumental examination of the patient. Carry out differential diagnosis of diseases. Establish a preliminary and clinical diagnosis.	PRS 3

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

<b>Code of ELO</b>	<b>Expected learning outcomes of the discipline</b>	<b>Code of PRS</b>
ELO 1	Ability to evaluate changes in the normal parameters of the blood system on the basis of laboratory data	PRS 2 PRS 3
ELO 2	Ability to evaluate changes in the normal parameters of the cardiovascular system according to the ECG, phonocardiography, functional samples (ortostatic, with maximum breath holding)	PRS 2 PRS 3
ELO 3	Ability to evaluate changes in the normal parameters of the respiratory system according to spirography.	PRS 2 PRS 3
ELO 4	Ability to evaluate the changes in the normal functioning of the gastrointestinal tract	PRS 2 PRS 3
ELO 5	Ability to identify the changes in the normal parameters of the of regulatory systems (endocrine and nerve).	PRS 2 PRS 3

#### 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 (general blood test).

ELO 2. - test tasks, theoretical questions, situational tasks (ECG, phonocardiography)

ELO 3. - test tasks, theoretical questions, situational tasks (spirography).

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

ELO 5. - test tasks, theoretical questions, situational tasks.

##### 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 clinical tasks.

Form of unit control: MCQs, written question and clinical tasks.

Form of semester control: final control (exam).

**Distribution of points received by applicants for higher education  
MODULE 1**

Current assessment and individual work																	
T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18
3	3	3	3	3	3	3	12	3	3	3	3	3	3	3	3	3	3

Current assessment and individual work														
T19	T20	T21	T22	T23	T24	T25	T26	T27	T28	T29	T30	T31	Main Module 1	Total
3	12	3	3	3	3	3	3	3	3	3	3	12	80	200

T1 – Introduction to physiology

T2 - Bioelectric occurrences on the membrane of the excitable cells. Resting membrane potential and mechanisms of its establishment. Action potential and its characteristics.

T3 - Effects of continual current on excitable tissue. Main indicators of tissue`s excitability.

T4 - Physiology of nerves. The mechanisms of excitation`s conduction on nerves.

T5 - Physiology of synapses. The mechanism of synaptic transmission in excitatory and inhibitory synapses.

T6 - Physiology of skeletal muscles.

T7 - Force and workload of muscles. Features of smooth muscle.

T8 - Submodule – MCQs control №1 «Physiology of excitable structures».

T9 - General patterns of central nervous system work. Physiological features of neuronal circuits. Excitation in nerve centers.

T10 - Inhibitory processes in the nerve centers, their features and physiological role. Basic principles of coordination of reflex activity.

T11 - The role of the nervous system in the regulation of motor functions of the body.

T12 - The role of the basal nuclei and the cerebral cortex in the regulation of motor functions of the body.

T13 - The sensory functions of the nervous system.

T14 - Pain and temperature sensation.

T15 - The visual analyzer.

T16 - Physiology of the ear and vestibular apparatus.

T17 - Physiology of taste, smell and interoceptive analyzer.

T18 - The physiology of the autonomic nervous system.

T19 - The influence of nervous system autonomic division on effector organs.

T20 - Submodule – MCQs control №2 «Physiology of the nervous system. Sensory organs».

T21 - Type of humoral regulation of the body function and general patterns of hormones` action.

T22 - The endocrine function of thyroid and parathyroid glands, kidneys.

T23 - The endocrine function of hypothalamic-pituitary system and regulation of its secretion. The hormones of the adrenal medulla.

T24 - The endocrine function of the adrenal cortex.

T25 - General adaptation syndrome (stress).

T26 - The endocrine function of the pancreas.

T27 - The endocrine function of gonads, zona reticularis, placenta, epiphysis and thymus.

T28 - The higher nervous activity (HNA). The physiological basis of behavior.

T29 - The features of the human higher nervous activity.

T30 - The role of motivations and emotions in behavior formation.

T31 - S3 - Submodule – MCQs control №3 «Physiology of the endocrine system. Physiological basis of behavior».

**Distribution of points received by applicants for higher education  
MODULE 2**

Current assessment and individual work																				
T1	T2	T3	T4	T5	T6	T7	T8	T9	T10	T11	T12	T13	T14	T15	T16	T17	T18	T19	T20	T21
3	3	3	3	3	3	3	3	3	3	3	3	9	3	3	3	3	3	3	3	3

Current assessment and individual work														
T22	T23	T24	T25	T26	T27	T28	T29	T30	T31	T32	T33	T34	Main Module 2	Total
9	3	3	3	3	3	3	3	3	3	9	3	3	80	200

- T1 - Components and major functions of blood. Composition and functions of blood plasma.  
T2 - Plasma proteins and physical and chemical properties of blood and plasma.  
T3 - Erythrocytes. Erythropoiesis. Hemoglobin and its compounds.  
T4 - The doctrine of blood group and Rh factor. Rules of transfusion.  
T5 - Physiological features and functions of white blood cells. Diagnostic importance of leucogram. Mechanisms of protection of cellular homeostasis of the organism.  
T6 - Anticoagulation and coagulation of the blood system.  
T7 - Acid-base homeostasis and mechanisms for its maintenance.  
T8 - Physiological mechanisms of the acid-base regulation.  
T9 - Morphofunctional characteristic of respiratory system  
T10 - Lungs` ventilation mechanism.  
T11 - Pulmonary and tissue gas exchange. Transport of respiratory gases by blood.  
T12 - Regulation of respiration.  
T13 - Submodule – MCQs control №1 “Physiology of the blood and respiratory system”.  
T14 - General characteristics of cardiovascular system functions. Heart electrical activity and its physiological importance.  
T15 - Electrocardiography – physiological basis.  
T16 - The heart ejection function.  
T17 - The regulation of the heart ejection function.  
T18 - The main laws of hemodynamic and its physiological interpretation.  
T19 - Physiology of microcirculation and venous system.  
T20 - Regulation of the systemic blood pressure  
T21 - Features of the regional hemodynamic. Hemodynamic in different functional states of the body.  
T22 - Submodule – MCQs control №2 «Physiology of the circulation system».  
T23 - General characteristics of the digestion. Digestion in the oral cavity.  
T24 - Digestion in the stomach. Regulation of the digestion in the oral cavity.  
T25 - The role of the pancreas, liver and gallbladder in digestion.  
T26 - Digestion in the small and large intestine.  
T27 - Absorption processes. The systemic mechanisms of hunger and satiety.  
T28 - Regulation of the digestion. The systemic mechanisms of hunger and satiety.  
T29 - The role of kidneys in excretion processes.  
T30 - The urinary formation processes.  
T31 - The neuroendocrine mechanisms of urine formation regulation. Sweating  
T32 - Submodule – MCQs control №3 «Physiology of the digestive and excretion system».  
T33 - Physiology of metabolism and energy exchange.  
T34 - Energy balance. Thermoregulation and its mechanism.

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

Type of activity of higher education applicant	Module 1		Module 2	
	Amount	Maximal score (total)	Amount	Maximal score (total)
Laboratory classes	28	84	31	93
Written testing for thematic evaluation	3	36	3	27
Module Control	1	80	1	80
<b>Total</b>	<b>32</b>	<b>200</b>	<b>35</b>	<b>200</b>

#### Evaluation criteria for modular control work

Score module is defined as the sum of estimates of current educational activity (in points) and assessment of the final module control (in points), which is proposed in the assessment of theoretical knowledge and practical skills according to lists supplied by discipline.

The maximum point student can get for each module (credit) – 200, these points includes 120 points for laboratory classes and 80 points for the final module control.

**Current control** is carried out in each class according to specific goals for each topic. In assessing students' educational activity should prefer standardized methods of control: testing, structured written work, a structured procedure for the control of practical skills in conditions close to reality.

#### *Evaluation of current educational activity:*

The weight of each topic within a module must be the same but may be different for different modules of a determined number of subjects and topics in the module.

At mastering of every theme of the module for current educational activity the student score for the 4-points traditional scale, which are then converted into points according to the number of topics in the module. The program has been applied such a system converting the traditional system of assessment scores:

Traditional mark	Conversion to points	
	Module 1	Module 2
"5"	3	3
"4"	2	2
"3"	1	1
"2"	0	0

The maximum points student can get during a module is 200 points. It is calculated by multiplying the number of points that correspond to the estimation of "5", the number of topics in the module with addition of marks for individual independent work.

The minimum points student can get during a module is calculated by multiplying the number of points that correspond to the estimation of "3", the number of topics in the module.

#### *Evaluation of individual independent work (individual tasks):*

Number of points for different types of individual independent work of students (IWS) depends on its size and importance, but not more than 10-12 points. These points are added to the amount of points that were gained by student for current educational activity.

#### *Evaluation of independent work:*

Evaluation of independent work of students, which is foreseen in a topic next to laboratory classes, which are carried out under the current control of topic on the current laboratory classes. Evaluation of topics that are submitted only on independent work and not included in the topics of laboratory classes is controlled at final module control.

***The final module control:***

Passing the test control using the tests of databases and booklets of Step 1 is mandatory for all students. Required test control is drawn up subject to successful resolution of not less than 70% of the proposed tests. Students who do not pass the mandatory test control, not permitted to final control on discipline. Final module control is carried out on completion of all topics module.

The form of the final module control should be standardized and include control of theoretical and practical training. Specific forms of final module control Physiology defined in the work study program.

**The maximum points for final module control are 80.**

Final module control is considered passed if the student scored at least 50 points.

**Evaluation of the discipline:**

The valuation for physiology is exposed only to students who have accrued all modules of discipline.

**The valuation of discipline is set as the average of estimates for modules that are structured academic discipline.**

The objectivity of the evaluation of educational discipline must be checked by statistical methods (correlation coefficient between current progress and results of final module control).

*Conversion of points in the discipline rates by ECTS scale and 4-point scale (traditional):*

The percentage of students determined in the elections for the students of the course within the relevant specialty.

The valuation of discipline FX, F («2») assigned to students who are not enrolled at least one module from discipline after completion of the study.

The valuation of discipline FX («2») assigned to students who do not get the minimum points for current educational activity or not made the final module control. They are eligible for re-passing of final module control, not more than 2 times during the winter holidays and for two (additional) weeks after the spring semester according to the schedule approved by the rector.

Students who were rated F at the end of the studies subject (not complete the subject with at least one module or don't get minimum points for current educational activity module) must undergo re-training for individual educational plan.

Total points for all types of studies	Rate ECTS	Rate according to national scale	
		for exam, course project (work), practice	for credit
180 – 200	<b>A</b>	well	Accepted
164-179	<b>B</b>	fine	
148-163	<b>C</b>		
128-147	<b>D</b>	satisfactorily	
120-127	<b>E</b>		
70-119	<b>FX</b>	Unsatisfactorily with the possibility of re-passing	Unaccepted with the possibility of re-passing
0-69	<b>F</b>	unsatisfactorily with obligatory repeated studing of the subject	unaccepted with obligatory repeated studing of the subject

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

### **MODULE 1. GENERAL PHYSIOLOGY.**

#### **Introduction to physiology.**

1. Methods of physiological research.
2. Basic concepts of physiology (function, physiological process, norm and regulation of the function).
3. Functional system as the basis for the formation of the physician clinical thinking.

#### **Physiology of the excitable tissues.**

1. Current understanding of the structure and function of the cell membranes.
2. Ion membrane channels and their role in the excitability of cell.
3. Ionic gradients of cells and mechanisms of their occurrence.
4. Establishing of the resting membrane potential. Nernst equation.
5. Action potential and its phases. Ionic mechanisms of action potential.
6. Effect of direct current on excitable tissues depending on its parameters.
7. The local response and its differences from the action potential.
8. The time-force curve and its physiological characteristics.
9. Polar Pfluger's irritation law and its physiological interpretation.
10. Refractory period of excitable cells and its mechanisms. Ratio phases of the action potential with refractory period of the cell membrane.
11. Lability of the excitable structures and its measurement.
12. Value of Chronaxymetry method in clinical practice.
13. Structural features of nerve fibers.
14. Physiologic properties of nerve fibers.
15. Classification of nerve fibers.
16. Mechanism of action potential conduction by myelinated and non-myelinated nerve fibers.
17. Physiological benefits of the saltatory conduction by nerves.
18. Structure of chemical and electrical synapses.
19. Mechanism of synaptic transmission. Formation EPSP and IPSP in chemical synapses.
20. Physiological characteristics of the mediators.
21. Interaction of the synaptic processes.
22. Features of neuromuscular synapses. Cholinomimetics and muscle relaxants.
23. Types of muscle tissue. Functions and properties of skeletal muscles.
24. Structure of the whole skeletal muscle, fiber and muscle sarcomere.
25. The molecular mechanisms of the contraction (sliding filaments theory). The role of  $Ca^{+2}$  in the mechanism of the contraction.
26. Motor units and their structure in different muscles.
27. Types of contraction of the whole skeletal muscle.
28. Mechanism of formation of the incomplete and complete tetanus in skeletal muscle.
29. Factors that can affect the muscles contraction.
30. Types of muscle work.
31. Fatigue and its mechanisms. Oxygen debt in the mechanism of the contraction.
32. Morphological and physiological features of smooth muscles.
33. Innervation of smooth muscles and synaptic transmission in effector synapses of smooth muscles.

## **Physiology of nervous system**

1. Classification of the nervous system.
2. Functional categories of cells in the nervous system.
3. Mechanisms of interaction between neurons in neuronal circuits.
4. Nerve center and its properties.
5. Reflex principle of CNS work.
6. Interaction of processes of excitation and inhibition in the central nervous system.
7. Inhibitory processes in the nerve centers and their physiological role.
8. Types of central inhibition and neural mechanisms of their occurrence.
9. Characteristics of presynaptic and postsynaptic inhibition.
10. Reciprocal, reverse and lateral inhibition, their significance.
11. Basic principles of coordination of reflex activity.
12. Neuronal organization of motor functions of the nervous system.
13. Participation of the spinal cord in the regulation of motor functions of the organism.  
Spinal shock.
14. The role of the hindbrain. the regulation of motor functions.
15. Functions of the motor nuclei of the middle brain.
16. Participation of different parts of the central nervous system in the formation of oriental reflexes.
17. The cerebellum and its participation in the regulation of motor functions of the body
18. Cerebrum. Its functions and structure.
19. The functions of cerebral cortex and its areas
20. The role of the basal ganglia.
21. The asymmetry of the human brain. Diffuse modulatory systems.
22. The method of electroencephalography (EEG) and its usage in physiological and clinical practice.
23. Types of senses.
24. The main part of a sensory system.
25. Characteristic of the somatosensory system.
26. The main nerve tracts of the somatosensory system.
27. The sensory function of different parts of the central nervous system (CNS): the middle brain, thalamus and the cerebral cortex.
28. The main temperature receptors.
29. Pain receptors, their localization and signification.
30. Spinothalamic tract.
31. The neurophysiological mechanism of pain.
32. The nociceptive and the antinociceptive system.
33. Methods of analgesia.
34. The optical system of the eye.
35. Mechanism of the light refraction.
36. Errors (abnormalities) of refraction and their correction (myopia, hyperopia, presbyopia, astigmatism).
37. A mechanism of accommodation.
38. Color perception.
39. Neural pathways for vision.
40. Physiology of the external, middle and inner ear (labyrinth). Functions of the hair cells

41. Physiological steps in sounds perception
42. The mechanism of the sound's coding: intensity and pitch
43. Neural pathway for hearing.
44. Physiological mechanisms of equilibrium. Static and dynamic equilibrium
45. Neural pathways of equilibrium.
46. Nystagmus and its clinical significance
47. Types, structure and functions of taste buds.
48. Primary tastes, the maximum sensitivity of different parts of the human tongue to them.
49. Neuronal pathway of taste.
50. Olfactory receptors.
51. The importance of taste and smell.
52. Neuronal pathway of olfaction.
53. Anatomical and functional features of the peripheral section of autonomic nervous system.
54. Characteristic of the sympathetic division of ANS.
55. Characteristic of the parasympathetic division of ANS.
56. The functional antagonism of sympathetic and parasympathetic divisions of ANS.
57. Autonomic ganglia and their physiological role.
58. The synaptic transmission in peripheral section of autonomic nervous system.
59. The role of different parts of the nervous system in the regulation of autonomic functions.
60. Integrative functions of the hypothalamus.
61. Functions of the limbic system.
62. The importance of the cerebral cortex in the regulation of body's autonomic functions.
63. Main autonomic reflexes and their characteristics, importance in clinical practice.
64. Forms of behavior. Higher and lower nervous activity.
65. Instincts as a component of behavior. Classification of instincts.
66. Types and properties of conditioned reflexes. Classification and mechanisms of conditioned reflexes formation.
67. Types of conditionally reflexive inhibition.
68. Motivation Theories of origin.
69. Emotions, structural basis, theory of origin. Classification of emotions.
70. Memory, its types and mechanisms.
71. Sleep. Types and phases of sleep. Biological significance. Mechanisms of sleep.
72. Features of Human HNA. Types of HNA.
73. Functional asymmetry of the cerebral hemispheres.

### **Physiology of the endocrine system**

1. The difference between nervous and humoral regulation. The main functions of the endocrine system.
2. Structural and functional organization of the endocrine system.
3. Classification and basic physiological properties of hormones.
4. Mechanism of hormones' action on target cells.
5. Regulation of the endocrine glands' functions.
6. Factors influencing the effective concentration of the hormone in plasma.
7. General pathophysiological mechanisms of endocrine pathology.
8. Hormones of the thyroid gland, mechanisms of their secretion and effects on target cells.

9. Physiological effects of iodinated hormones, calcitonin and regulation of their secretion.
10. The endocrine pathology associated with thyroid function disturbances.
11. Parathyroid hormone, its physiological effects, regulation of secretion. The endocrine pathology associated with disturbance of the parathyroid glands' function.
12. The endocrine function of the kidneys. The concept of RAAS (renin-angiotensin-aldosterone system).
13. General understanding of the hypothalamic-pituitary system functions. The hypothalamic releasing-hormones and their physiological role.
14. The physiological effects of neurohypophysis hormones and regulation of their secretion.
15. The physiological effects of adenohypophysis hormones and regulation of their secretion.
16. The adrenal medulla hormones and regulation of their secretion.
17. Basic physiological effects of epinephrine and norepinephrine. Adrenergic receptors and their functions.
18. The functional anatomy of adrenal cortex.
19. The physiological effects of mineralocorticoids and regulation of their secretion.
20. The endocrine function of the heart.
21. The physiological effects of glucocorticoids and regulation of their secretion.
22. The endocrine diseases associated with a violation of the adrenal cortex hormones' secretion.
23. The concept of general adaptive syndrome (stress).
24. Types of stress and stressors.
25. The mechanisms of stress at different stages of stress-reaction.
26. The main stress-limiting (anti-stress) systems of the organism.
27. Diagnostics, treatment and prevention of stress conditions. Stress and disease.
28. General characteristics of the endocrine function of the pancreas.
29. Physiological effects of insulin and regulation of its secretion.
30. Physiological effects of glucagon and regulation of its secretion.
31. Violation of the endocrine function of the pancreas.
32. The concept of type 1 diabetes and Type II diabetes.
33. Hormones of the male and female gonads.
34. The sex hormones functions and regulation of their secretion.
35. Physiological effects of adrenal cortex sex hormones and regulation of their secretion.
36. The endocrine function of the placenta.
37. Hormones of epiphysis and thymus gland, their physiological role.
38. Mechanism of local humoral regulation.

## **MODULE 2. PHYSIOLOGY OF THE VISCERAL SYSTEMS.**

### **Physiology of blood**

1. Conception of internal environment.
2. Homeostasis. The notion of norm, constants, homeokinesis.
3. General characteristics of blood. Blood functions.
4. Hematocrit and its clinical evaluation.
5. The chemical composition of plasma. Characteristic of organic substances.
6. The electrolytes of plasma.
7. Characteristics of plasma proteins and their functions.
8. The physiological significance of albumin. Clinical evaluation of ESR
9. Characteristics of globulin, fibrinogen, and their significance.

10. Blood viscosity, colloidal stability of the plasma.
11. Osmotic and oncotic blood pressure.
12. Hemolysis. The osmotic resistance of erythrocytes.
13. The concept of physiological saline and colloid substitutes.
14. General characteristics of erythrocytes.
15. Hemoglobin functions.
16. Erythropoiesis and its regulation.
17. The concept of anemia. Causes of anemia.
18. Color index.
19. Blood groups according to the ABO.
20. Blood groups according to the Rh factor.
21. Methods of determination of blood groups of ABO system and Rh factor.
22. Basic rules of blood transfusion. The concept of hemotransfusion shock. Rh conflict and its prevention.
23. General characteristics of leukocytes.
24. Leukogram, its age related and pathological changes
25. Immunity.
26. Immunity types and basic mechanisms.
27. Cooperation of immunocompetent cells in the immune response.
28. Blood platelets and their functions.
29. General characteristics of the hemostasis mechanisms.
30. Mechanisms of primary hemostasis.
31. Mechanisms of coagulation hemostasis.
32. Anticoagulation system of blood.
33. Typical abnormal conditions accompanied by insufficiency and excessive activity of coagulation hemostasis.
34. Methods of clinical assessment of the blood coagulation system.
35. Concept about pH and buffer properties of solutions.
36. pH of blood and its significance for homeostasis.
37. Blood buffer systems and their physiological characteristics.
38. Participation of the respiratory system in the regulation of acid base balance.
39. The involvement of the kidneys in the regulation of acid base balance.
40. The role of the gastrointestinal tract and the liver in the displacement of acid base balance.
41. Clinical and physiological characteristics of typical acid base disorders.

## **Respiratory system**

1. The major stages of breathing and their physiological characteristics.
2. Structural components of respiratory system and their role in breathing.
3. Physiological features of the upper and lower respiratory tract.
4. Non-respiratory pulmonary functions.
5. Biomechanics of respiratory cycle.
6. The factors affecting pulmonary ventilation.
7. Oxygen cost of breathing in the norm and pathology.
8. The functional assessment of pulmonary ventilation by spirometry method.
9. Gas exchange mechanisms between alveolar and atmospheric air.
10. Respiratory gas exchange between alveolar air and venous blood in the pulmonary capillaries.
11. The factors affecting pulmonary gas exchange between alveolar air and venous blood in the pulmonary capillaries.
12. Matching mechanisms of ventilation and alveoli blood supply.

13. Gas exchange between tissues and blood in capillaries of systemic circulation.
14. Oxygen transport by blood.
15. Oxyhemoglobin dissociation curve and factors affecting it.
16. Carbon dioxide transport by blood.
17. Exchange of gases between venous blood and alveolar air.
18. Exchange of gases between tissues and blood.
19. The brainstem respiratory center and its participation in the regulation of respiration.
20. Mechanoreceptors` respiratory reflexes.
21. Chemoreceptors` respiratory reflexes.
22. Influence of non-specific factors on respiration.
23. The features of breathing regulation underwater at a great depth.
24. The functional system of maintenance the constancy of gas composition of arterial blood.

### **Physiology of cardiovascular system**

1. The morphological organization of the cardiovascular system.
2. The functions of the heart.
3. Electrical activity of the heart and its physiologic meaning
4. Pacemaker activity of atypical cardiomyocytes.
5. Action potential of contractile cardiomyocytes and its ionic mechanisms.
6. The refractory period of the myocardium and it's physiological meaning.
7. The excitation-contraction coupling in the myocardium.
8. The conductive heart system and its participation in the coordination of the heart pumping function.
9. Basic elements of ECG and their origin.
10. Electrocardiographic leads and their axes in the frontal and horizontal plane.
11. The concept of an integral electric vector of the heart and its projection on the axis of electrocardiographic leads.
12. Basic parameters of a normal electrocardiogram.
13. Using of ECG in the diagnosis of heart disease.
14. Phase structure of the heart cycle.
15. The pressure-volume curve during the heart cycle.
16. Basic physiological parameters of the heart pumping function.
17. Heart sounds and their physiological mechanisms. Diagnostic value of phonocardiography.
18. Features of the metabolism in the myocardium.
19. Control of the heart pumping function. Myogenic regulation of the heart.
20. Nervous intracardiac regulation of the heart.
21. The influence of the autonomic nervous system on the heart work. Autonomic cardiac reflexes.
22. Main subcortical centers of regulation of the heart. Influence of the cerebral cortex on the heart work.
23. The role of hormones in the regulation of heart activity.
24. Dependence of the heart's work on the ionic composition of blood.
25. Metabolism in the myocardium.
26. General description of the vascular system functions.
27. Basic laws of hemodynamics and their physiological interpretation. Ohm's Law, Poiseuille's Law.
28. Determination of systemic blood pressure and total peripheral resistance.
29. Types of blood flow in the vascular system. Reynolds number.
30. Blood viscosity and its effect on the blood flow in vessels.

31. Blood flow in the arteries. Blood pressure and its measurement.
32. Blood flow in arterioles and mechanisms for its regulation.
33. Structure of microcirculatory bed.
34. Hemodynamics in capillaries and mechanisms of substances' transport through the capillary wall.
35. Exchange processes in the capillaries. Starling's theory.
36. The role of venules and veins in the cardiovascular system.
37. Mechanisms of venous blood return to the heart.
38. The effect of gravity on hemodynamics.

### **Physiology of digestion**

1. Digestion of the food in the mouth. The chewing and its regulation.
2. Swallowing. The phases of swallowing.
3. Chemical properties and functions of saliva.
4. Regulation of the salivation.
5. The composition and chemical properties of gastric juice.
6. Enzymatic action of gastric juice. Role of hydrochloric acid in digestion.
7. Secretory glands in different parts of the stomach.
8. Phases of gastric secretion and their characteristics. Dependence of gastric secretion on the nature of the food.
9. Motor function of the stomach and its regulation.
10. Composition and properties of the pancreatic juice.
11. The enzymes of pancreatic juice and their impact on chyme.
12. Regulation of pancreatic secretion.
13. Composition and properties of bile. The role of bile in digestion.
14. Regulation of secretion and excretion of bile.
15. General characteristics of digestion in the small intestine.
16. The relationship between the cavity and membrane digestion.
17. Secretory and enzymatic function of the small intestine and its regulation.
18. Motor function of the small intestine and its regulation.
19. The role of the colon in digestion. The bacterial flora of the colon.
20. The role of different parts of the gastrointestinal tract in absorption processes.
21. The mechanism of absorption of substances in the digestive tract. The absorption of water, electrolytes, monomers of carbohydrates, proteins and fats.
22. Functional organization of the digestion centers in the CNS.

### **Physiology of kidney**

1. Morphofunctional features of kidneys. The structure of the nephron. Features of blood supply of kidneys.
2. General characteristics of the process of urine formation.
3. Glomerular filtration and its mechanisms.
4. Clearance, its diagnostic value to assess the urine formation.
5. Tubular reabsorption and its mechanisms.
6. Reabsorption of water and electrolytes in the distal nephron segment.
7. The mechanism of reabsorption in the loop of the nephron.
8. Tubular secretion and its physiological mechanisms.
9. Chemical composition and properties of the primary and final urine.
10. Regulation of renal blood flow.
11. Excretory function of sweat and sebaceous glands and the regulation of their activities.

### **Physiology of metabolism and thermoregulation**

1. The essence of metabolism in the body. Nitrogen balance.
2. The basic physiological principles of nutrition.
3. The physiological role of water and electrolytes. Regulation of water and electrolyte metabolism.
4. The physiological role of proteins, fats and carbohydrates.
5. Regulation of heat production and heat return from the body.
6. A functional system maintaining constant body temperature.
7. Energy homeostasis and transformation of energy metabolism.
8. Basal metabolism and factors that determine it.
9. Working exchange energy. Energy costs during different types of body work.
10. Sources of energy in the body. Caloric value of nutrients.
11. Specifically-dynamic influence of the nutrients on the metabolism rate.

### **The list of practical skills**

1. To perform the calculation of functions` parameters and to make a scheme of processes that takes place in excitable tissues.
2. To make schemes and explain the structure and mechanisms:
  - contours of biological regulation, reflex arcs of motor reflexes;
  - development of excitation and inhibition processes in the CNS, summation and coordination of reflexes;
  - reflex arcs of motor reflexes at all levels of CNS and pathways that provide different levels of interaction in CNS;
  - reflex arcs of autonomic reflexes, providing regulation of visceral functions;
  - action of various hormones on target cells and regulation of secretion, outlines the regulation of visceral functions involving hormones.
3. To valuate the state of sensory systems using parameters of their research functions.
4. To valuate and interpret the results of studies describing the types of higher mental function of CHS of the person.
5. Determine hemoglobin in the blood by the method of Sali, evaluate the results.
6. Identify the study of blood group according to AB0 system, make a conclusion.
7. Calculate the color index of blood, make a conclusion.
8. Determine the hematocrit rate, make a conclusion.
9. To measure the blood pressure, make a conclusion.
10. Determine the direction and amplitude of waves on electrocardiogram in standard leads. Make a conclusion.
11. Determine the duration of the cardiac cycle based on the analysis of ECG. Make a conclusion.
12. Calculate the length at the cardiac cycle, make a conclusion.
13. Measure the lung capacity by spirometry. Make a conclusion.
16. Calculate the minute volume of breathing, alveolar ventilation. Make a conclusion.
17. Determine oxygen consumption for 1 minute, make a conclusion.

### **8. Individual work**

Individual students work is performed by studying of scientific literature on the topic of employment.

## 6. THE PROGRAM OF SUBJECT

### 6.1 THE CONTENT OF THE DISCIPLINE

#### Module 1. General Physiology

##### Submodule 1. Introduction.

###### *Specific goals:*

*To explain physiological basis of the research methods during carrying out an experiment on animals and researching of functions of human body under different physiological conditions.*

*To interpret the concept of "physiological system" of the body and the role of regulatory mechanisms in achieving adaptive responses.*

*Analyze stages of physiology development as fundamental discipline in medicine and the contribution of individual researchers in each of its stages.*

###### **Topic 1. Introduction to physiology.**

Physiology is a branch of medicine that studies the functions of the human body, the underlying physiological processes and mechanisms of their regulation. Basic concepts of physiology (function, physiological process, norm and regulation of the function). Functional system as the basis for the doctor clinical thinking formation.

###### **Topic 2. The main stages of physiology development. The history of physiology in the 19<sup>th</sup> century. The physiological school in Ukraine.**

The main stages of physiology development;

The history of physiology in the 19<sup>th</sup> century;

The physiological school in Ukraine

##### Submodule 2. Physiology of the excitable tissues.

###### *Specific goals:*

*Explain the schema of the development in time of the action potential, changes of resting membrane potential during depolarization and hyperpolarization of the cell membrane; interpret the mechanism of the origin of resting membrane potential in different cells. Explain the parameters of excitability in clinical practice. Schematically portray the mechanism of conduction the excitation by myelinated and nonmyelinated nerve fibers. Schematically depict the mechanism of synaptic transmission and graphic registration of excitatory postsynaptic potential and inhibitory postsynaptic potential. Describe a schema of the sarcomere during its contraction and relaxation, sketch different types of muscle contractions. Define the human forearm muscle strength by dynamometry, to calculation of muscle fatigue curve by recording using erhooraf.*

*Resting membrane potential, action potential and their physical, physiological characteristics and methods of measurement, patterns of occurrence of local responses and action potential in excitable tissues exposed to continual current, stimulation laws and their physiological interpretation. To know the mechanism of conduction the excitation myelinated and nonmyelinated fibers, the main factors, which determine the speed of conduction the excitation by integral nerves, classification of nerve fibers; the structure of chemical synapses, their classification, understand the role of mediators in mechanism of transferring excitation or inhibition, features of neuromuscular synapses and ways of blocking transmission in these synapses.*

###### **Topic 3. Bioelectric occurrences on the membrane of the excitable cells. Resting membrane potential and mechanisms of its establishment. Action potential and its characteristics.**

Irritability – is a general property of living matter change its state by the action stimulus. Excitability - ability of certain tissues to generate AP.

Resting membrane potential is the constant potential difference between outer and inner side of the cell membrane, through which the cell can excite under the influence of the stimuli.

Current understanding of the structure and function of cell membranes. Ion membrane channels and their role in the excitability of cell. Ionic gradients of cells and mechanisms of their occurrence. Formation of resting membrane potential. Nernst equation. Action potential and its phases. Ionic mechanisms of action potential.

**Topic 4. Effects of continual current on excitable tissue. Main indicators of tissue's excitability.**

Effect of continual current on excitable tissues depending on its parameters. The local response and its differences from the action potential. The critical level of depolarization – it is the value of depolarization of the membrane, where local response goes in AP. Time curve of force and its physiological characteristics. Polar Law irritations Pfluger and its physiological interpretation. Refractory of excitable cells and its mechanisms. Ratio phases of the action potential refractory period of the cell membrane. Lability of excitable structures and their measurement. Chronaksymetri is value method in clinical practice.

**Topic 5. Physiology of nerves. The mechanisms of excitation's conduction on nerves.**

Structural features of nerve fibers. Physiologic properties of nerve fibers. Classification of nerve fibers. Mechanism of conduction the excitation by myelinated and non-myelinated nerve fibers. Physiologic benefits saltatory conduction of excitation by nerves.

**Topic 6. Physiology of synapses. The mechanism of synaptic transmission in excitatory and inhibitory synapses.**

Structure and classification of synapses. Structure of chemical and electrical synapses. Mechanism of synaptic transmission. Formation EPSP and IPSP in chemical synapses. Physiological characteristics of mediators. Interaction of synaptic processes. Features of neuromuscular synapses. Cholinomimetics and muscle relaxants.

**Topic 7. Physiology of skeletal muscles.**

Types of muscle tissue. Functions and properties of skeletal muscles. Structure of a whole skeletal muscle, fiber and muscle sarcomere. Molecular mechanisms of the contraction (sliding filaments theory). Role of  $Ca^{+2}$  in the mechanism of the contraction. Motor units and their structure in different muscles. Types of contraction of the holistic skeletal muscle. Mechanism of formation of the incomplete and complete tetanus in skeletal muscle.

**Topic 8. Force and workload of muscles. Features of smooth muscle.**

Types of muscle work. Fatigue. Morphological features of smooth muscle. Physiological characteristics of smooth muscle. The mechanism of smooth muscles' contraction

**Topic 9. Submodule – MCQs control №1 «Physiology of excitable tissues»**

**Submodule 3. Nervous regulation of the body functions.**

***Specific goals:***

*Describe the contours of the regulation of biological functions, explaining the role of feedback in providing adaptive response.*

*To explain the mechanisms of information transmission in the central nervous system synapses, the role of neurotransmitter, neuromodulator.*

*To explain the mechanisms of excitation and inhibition, summation of this processes and role in integrative functions of the central nervous system.*

*To analyze the principles of coordination of reflexes involving the relevant neural circuits in ensuring adaptive reactions.*

*To analyze the role of different levels of the central nervous system in providing of adaptive response.*

**Topic 10. General patterns of central nervous system work. Physiological features of neuronal circuits. Excitation in nerve centers.**

Anatomical and physiological features of nervous system, functional characteristics of the nervous system cells, structure and functions of neuronal circuits in CNS (schematically portray the arrange of neurons and structure of nervous circuits in CNS).

Classification of the nervous system. Functional categories of cells in nervous system. Types of neurons according to their function. Functional classification of neuroglia. Diverging and converging circuits of nervous system.

**Topic 11. Inhibitory processes in the nerve centers, their features and physiological role. Basic principles of coordination of reflex activity.**

Inhibitory synapses. Postsynaptic inhibition, development of inhibitory postsynaptic potential. Presynaptic inhibition, mechanisms of development.

Reciprocal, reverse, lateral inhibition and their significance. The main principles of reflex activity coordination.

Levels of CNS, their interaction in ensuring of the adaptive reactions of the body. Hemato-encephalic barrier, its structure and physiological role.

**Submodule 4. The role of the central nervous system in the regulation of motor functions.**

*Specific goals:*

*To make conclusions about the state of motor functions – poses, locomotions, motor reflexes that occur after the experiment section at different levels of the central nervous system and under the injury of motor structures.*

*To make conclusions about the state of motor systems, structures that combine different levels of the central nervous system, and their organization.*

*To make conclusions about the state of motor reflexes, those that are closed at different levels of the central nervous system, to assess their role in the sensory and motor functions.*

*To explain the role of the cerebral cortex and the limbic system in the formation of the systemic activity of the organism.*

*To explain the physiological basis of electroencephalography.*

**Topic 12. The role of the nervous system in the regulation of motor functions of the body.**

Neuronal organization of motor functions of the nervous system.

Participation of the spinal cord in the regulation of motor functions of the organism. Spinal shock.

The role of the hindbrain. the regulation of motor functions.

Functions of the motor nuclei of the middle brain.

Participation of different parts of the central nervous system in the formation of toriental reflexes.

The cerebellum and its participation in the regulation of motor functions of the body.

**Topic 13. Physiology of the brainstem, the cerebellum and the diencephalon.**

The role of the brainstem in the regulation of motor functions. The descending motor pathways and their role in regulation of alpha and gamma motor neurons activity. Hindbrain role in ensuring antigravity posture (vestibular nuclei and the reticular formation). Motor reflexes of the brainstem: static and stato-kinetic.

The functions of motor and sensory nuclei of the midbrain.

The role of the red nucleus in the regulation of motor activity of the body. Effect of red nuclear on the work of muscles flexor and extensor.

The basic reflexes that are ensured by the midbrain.

Functional and structural organization of the cerebellum and its afferent and efferent connections, their physiological role. The role of inhibitory neurons that are located in the cerebellar cortex. The interaction between the cerebellar cortex and its nuclei with vestibular nuclei. Clinical signs that are caused by injury of the cerebellum and physiological

mechanisms.

**Topic 14. The role of the basal nuclei and the cerebral cortex in the regulation of motor functions of the body.**

Role in the regulation of muscle tone and complex motor activities, in the organization and implementation of motor programs. The functions of the striatum, its interaction with the black substance and other structures. The role of the motor areas of the cortex in the regulation of motor functions. The primary motor area (field 4) of the cortex its functional role in the regulation of motor functions.

The interaction between different levels of the central nervous system in the regulation of motor functions. Human locomotion, its regulation. Programming of the movements. The functional structure of voluntary movements.

**Submodule 5. Physiology of the sensory system.**

*Specific goals:*

*To analyze the state of sensory system's functions, structural elements and additional structures according to special criteria.*

*To interpret the function of information channels.*

*To analyze the parameters of sensory system: absolute and differential sensitivity thresholds appropriate, state receptive fields, forming sensory images.*

*To analyze age features of formation and functions of sensory system.*

*To explain the physiological basis of each of the research methods of sensory systems.*

**Topic 15. The sensory functions of the nervous system.**

The main sensory functions of the nervous system, mechanisms and processing of sensory information, explore and analyze perception and processing of different types of sensations in different areas of the skin.

Basic concepts of sensory physiology.

The structural and functional organization of sensory system, receptors: classification, the main properties, mechanisms of excitation, functional lability. Regulation of the receptors function. The methods of research of the receptors excitability. The role of the spinal cord, brainstem, thalamus, in transmission and transformation of the afferent excitations.

**Topic 16. Pain and temperature sensation.**

Structural and functional organization of somatosensory system (skin and proprioceptive sensation). The physiological basis of pain.

Nociceptive sensation, physiological characteristics and classification of nociceptors. Physiological importance of pain perception.

**Topic 17. The visual analyzer.**

The optical system of the eye and its characteristics. Correction of the refraction defects.

Photoreceptors and their functions. Phototransduction

Color perceptions

Neural pathways for vision

**Topic 18. Physiology of the ear and vestibular apparatus.**

Physiology of the external, middle and inner ear (labyrinth). Functions of the hair cells.

Physiological steps in sounds perception

Coding sound intensity and pitch

Neural pathway for hearing. Hearing impairment

Physiological mechanisms of equilibrium. Static and dynamic equilibrium

Neural pathways of equilibrium.

Nystagmus and its clinical significance

**Topic 19. Physiology of taste, smell and interoceptive analyzer.**

Types, structure and functions of taste buds.

Primary tastes. Signal transduction in taste.

Neuronal pathway of taste.

Olfactory receptors. Olfactory transduction.

Neuronal pathway of olfaction.

**Topic 20. The physiology of the autonomic nervous system.**

Anatomical and functional features of the peripheral section of autonomic nervous system.

Characteristic of the sympathetic division of ANS.

Characteristic of the parasympathetic division of ANS.

The functional antagonism of sympathetic and parasympathetic divisions of ANS.

Autonomic ganglia and their physiological role.

The synaptic transmission in peripheral section of autonomic nervous system.

**Topic 21. The influence of nervous system autonomic division on effector organs.**

The role of different parts of the nervous system in the regulation of autonomic functions.

Integrative functions of the hypothalamus.

Functions of the limbic system.

The importance of the cerebral cortex in the regulation of body's autonomic functions.

Main autonomic reflexes and their characteristics, importance in clinical practice.

**Topic 22. Submodule – MCQs control №2 «Physiology of the nervous system. Sensory organs».**

**Submodule 6. Humoral regulation and role of endocrine glands in regulation of the visceral functions**

*Specific goals:*

*Analyze adjustable parameters and make conclusion about mechanisms of the regulating the endocrine glands. Making conclusions about the state of its physiological functions systems and organs by changing the concentration of hormones in the body. Analyze adjustable parameters and draw conclusions about the state of mechanisms of regulation of linear growth of the body, physical, mental and sexual development involving hormones. Analyze adjustable parameters and make conclusions about the state mechanisms of regulation of homeostasis under the action of hormones.*

**Topic 23. Type of humoral regulation of the body function and general patterns of hormones' action.**

Overview of the Endocrine System

Hormones, Receptors and Target Cells. Hormone chemistry

Factors affecting the concentration of hormone

Mechanism of Action of hormone on the target cell.

**Topic 24. The endocrine function of thyroid and parathyroid glands, kidneys.**

Synthesis and mechanism of action of thyroid hormones.

Physiologic effects of thyroid hormones.

Thyroid disease states.

Control of thyroid hormone synthesis and secretion.

Calcitonin and its physiological role.

Physiologic effects and of parathyroid hormone.

Control of parathyroid hormone secretion.

Disease states of parathyroid hormone secretion.

Hormonal substances of kidney.

**Topic 25. The endocrine function of hypothalamic-pituitary system and regulation of its secretion. The hormones of the adrenal medulla.**

Physiologic effects of growth hormone. Disease states relating to somatotropin

Physiologic effects of thyroid-stimulating hormone

Physiologic effects of adrenocorticotrophic hormone

Control of hormone secretion (somatotropin, thyrotropin, adrenocorticotrophic hormone)

Physiologic effects of prolactin. Control of prolactin secretion

Physiologic effects of luteinizing and follicle stimulating hormones  
 Control of gonadotropin secretion  
 Physiologic effects and secretion control of antidiuretic hormone  
 Physiologic effects and secretion control of oxytocin

**Topic 26. The endocrine function of the adrenal cortex.**

Functional anatomy of the adrenal cortex.  
 Physiological effects of mineralocorticoids. Regulation of secretion and disease states. Physiological effects of glucocorticoids. Regulation of secretion and disease states. Adrenal sex hormones.  
 The endocrine function of the heart.  
 Hormones of male and female gonads.  
 Effects of sex hormones and regulation of their secretion.  
 The endocrine function of the placenta.

**Topic 27. General adaptation syndrome (stress).**

The concept of general adaptive syndrome (stress).  
 Types of stress and stressors.  
 The mechanisms of stress at different stages of stress-reaction.  
 The main stress-limiting (anti-stress) systems of the organism.  
 Diagnostics, treatment and prevention of stress conditions. Stress and disease.

**Topic 28. The endocrine function of the pancreas.**

Functional Anatomy of the Endocrine Pancreas  
 Insulin Synthesis and Secretion  
 Insulin Deficiency and Excess Diseases  
 Physiologic Effects of Glucagon  
 Control of Glucagon Secretion

**Topic 29. The endocrine function of gonads, zona reticularis, placenta, epiphysis and thymus.**

The Pineal Gland and Melatonin. Synthesis, Secretion and Receptors  
 Biological Effects of Melatonin

**Submodule 7. Physiological basis of behaviour**

*Specific goals:*

*To explain the physiological basis of research methods of the higher nervous activity: formation, conservation and inhibition of the reflexes; irritation and injury of the structures of the forebrain, which take part in higher integrative functions of the CNS; registration of EEG.*

*To explain the mechanisms of biological needs and motivations, and their role in the formation of congenital and acquired types of behaviour*

*To explain the mechanisms of emotions occurring and their role in behavioral reactions of the body under physiological criteria of emotions.*

*Analyze age characteristics of higher nervous activity of the organism.*

*To interpret the basic properties of the nervous processes – excitation and inhibition, causing the type of nervous system (strength, balance and mobility).*

**Topic 30. The higher nervous activity (HNA). The physiological basis of behaviour.**

The higher mental functions of the CNS, types of temperament.  
 Physiological basis of behavior. Inherited forms of behavior.

**Topic 31. The features of the human higher nervous activity.**

The needs and motivations, their physiological mechanisms and role in behavior formation. Emotions, types, mechanisms and biological role. Biological theories of emotion its characteristics, importance for clinical practice.

**Topic 32. The role of motivations and emotions in behavior formation.**

33. Submodule – MCQs control №3 «Physiology of the endocrine system. Physiological

basis of behaviour».

### **Module 1.**

## **Module 2. Physiology of visceral systems.**

### **Submodule 8. System of the blood.**

#### ***Specific goals:***

*To interpret the concept of the blood system, mechanisms of its regulation that are based on the analysis of parameters of homeostasis: blood volume, acid-base balance, osmotic pressure, quantity and quality of plasma and formed elements of the blood. To interpret the physiological laws of blood functions: respiratory, transporting and protective. To interpret the physiological laws of functions those are maintaining the liquid state of blood and development of blood hemostasis under state of blood vessels injury. Making conclusions about the state of physiological functions that are carried out with the participation of the blood system, based on quantitative and qualitative blood parameters: hematocrit rate, the number of red blood cells, hemoglobin, white blood cells, platelets, leukocyte formula, color index, erythrocyte sedimentation rate (ESR), coagulation time, duration of bleeding. To analyze age-related changes in blood composition, functions and mechanisms of regulation. To explain the physiological basis of research methods of the blood system: the number of blood cells, hemoglobin, ESR, osmotic resistance of red blood cells, duration of bleeding time coagulation blood grouping in ABO and SDE.*

#### **Topic 1. Components and major functions of blood. Composition and functions of blood plasma.**

Conception of internal environment. Homeostasis. General characteristics of blood. Hematocrit and its clinical evaluation. Blood functions

The chemical composition of plasma. The electrolytes of plasma

#### **Topic 2. Plasma proteins and physical and chemical properties of blood and plasma.**

Characteristics of plasma proteins and their functions.

The physiological significance of albumin.

Characteristics of globulin, fibrinogen, and their significance.

Osmotic and oncotic blood pressure.

Hemolysis. The osmotic resistance of erythrocytes.

The concept of physiological saline and colloid substitutes.

The concept of viscosity of the blood, erythrocyte sedimentation rate.

#### **Topic 3. Erythrocytes. Erythropoiesis. Hemoglobin and its compounds.**

Red blood cells, their structure, their importance for the life of the body.

Features of metabolic processes in the erythrocyte.

Effect of different physiological conditions on the number of red blood cells.

Erythropoiesis and its regulation. Intrinsic factor of castle

Structure of hemoglobin. Types of hemoglobin (physiological). The compounds of hemoglobin.

Features of respiratory function of hemoglobin. The oxygen capacity of blood.

The products of hemoglobin metabolism. Iron metabolism.

Color index, its size, method of its calculation, the clinical significance.

#### **Topic 4. The doctrine of blood group and Rh factor. Rules of transfusion.**

Antigenic properties of blood. Agglutination, its causes and consequences.

Blood group according ABO system

Rh system, its characteristics, value for medicine. The concept of other antigenic system erythrocytes.

Blood Type Testing.

Basic rules for blood transfusion. The concept of transfusion shock. Rh conflict

and its prevention. Blood and substitutes solutions.

**Topic 5. Physiological features and functions of white blood cells. Diagnostic importance of leucogram. Mechanisms of protection of cellular homeostasis of the organism.**

The importance of leukocytes for our body

Concept of leukopenia and leukocytosis. Physiological leukocytosis

Physiological features of different kinds of leukocytes

Leucogram and its clinical signification

The pathological changes in leucogram

Immune system: definition, function.

Non-specific mechanisms of cellular and humoral immunity.

Mechanisms of specific cellular and humoral immunity. Immunocompetent

Primary and secondary immune response.

Cooperation of immune cells in the immune response.

**Topic 6. Anticoagulation and coagulation of the blood system.**

Blood platelets and their functions.

Description of the primary (vascular-platelet) hemostasis. The cellular factors of blood clotting.

The essence of the second (coagulation) hemostasis. Plasma clotting factors.

External and internal ways of clotting. A common way of coagulation hemostasis.

Fibrinolysis and its mechanisms.

Violation of blood clotting.

**Topic 7. Acid-base homeostasis and mechanisms for its maintenance. Physiological mechanisms of the acid-base regulation.**

The concept of pH and buffering properties of solutions.

The blood pH and its importance for homeostasis.

Buffer systems of internal environment.

Bicarbonate buffer system and its characteristics. Equation Henderson-Hasselbalch.

Phosphate buffer system.

Characterization of protein buffer.

The value of hemoglobin buffer.

The main physiological parameters of acid-base status.

Involvement of the respiratory system in the regulation of acid-base status.

Renal participation in the regulation of acid-base status.

The role of the gastrointestinal tract and liver shifts in acid-base balance.

Compensation disorders of acid-base balance.

Landslides pH in normal and pathological conditions.

**Topic 8. Hemathopoesis and its regulation. Age-related changes in the blood system.**

Hemathopoesis and its regulation. Age-related changes in the blood system. Regulation of the blood coagulation system. Age-related changes in hemostasis system.

**Submodule 9. Respiratory system.**

**Specific goals:**

*To interpret the concept of the respiratory system and regulatory mechanisms of the gas homeostasis parameters that are based on the analysis of physiological criteria of the functions of the executive structures of the system, which support breathing.*

*Make conclusions about the state of each of the stages in the process of breathing that are based on the analysis of parameters that characterize the external breathing, diffusion of gases through the respiratory membrane, transport of gases, blood, diffusion of gases between blood and tissues according to the level of metabolism. Analyze adjustable*

*parameters that are characterized the state of gas exchange, and make conclusions about the mechanisms of breathing regulation under different conditions. To explain the physiological basis of spirometry, spirometry, determine the parameters of gas exchange.*

**Topic 9. Morphofunctional characteristic of respiratory system.**

The steps of external respiration. Nonrespiratory functions of lungs

The inspiratory muscles. The biomechanics of breathing

Transference of breathing movements from chest to the lungs

The elastic recoil of lungs. The physiological role of surfactant

The mechanism of inhale and exhale

The function of airways

Static and dynamic indexes of lungs ventilation

**Topic 10. Lungs` ventilation mechanism.**

Biomechanics of respiratory cycle.

The factors affecting pulmonary ventilation.

Oxygen cost of breathing in the norm and pathology.

The functional assessment of pulmonary ventilation by spirometry method.

Gas exchange mechanisms between alveolar and atmospheric air.

**Topic 11. Pulmonary and tissue gas exchange. Transport of respiratory gases by blood.**

Gas exchange between atmospheric and alveolar air.

Gradient partial pressures of gases in the alveolar air and arterial blood.

Diffusion capacity of the lungs. The relationship between alveolus blood supply and their ventilation.

Transport of oxygen in blood.

Oxyhemoglobin dissociation curve and its physiological characteristics.

Factors affecting the oxyhemoglobin dissociation curve.

Bohr's effect and its physiological significance.

Haldane's effect and its importance in the transport of CO<sub>2</sub>.

Transport of carbon dioxide in blood.

Exchange of gases between venous blood and alveolar air.

Exchange of gases between tissues and blood.

**Topic 12. Regulation of respiration.**

Structures of the CNS that provide respiratory periodicals.

Mechanoreceptors' respiratory reflexes.

Chemoreceptors' respiratory reflexes.

Effect of nonspecific factors in breathing.

The mechanism of adaptation to prolonged hypoxia.

Functional system maintaining the sustainability of arterial blood gas composition.

**Topic 13. Submodule – MCQs control №1 “Physiology of the blood and respiratory system”.**

**Submodule 10. Circulatory system.**

***Specific goals:***

*To interpret the concept of the circulatory system, mechanisms of regulation of stroke volume as an integral indicator of circulation that is based on the analysis of homeostasis parameters according to the level of metabolism. To interpret the physiological properties of the heart, providing its pumping function (automatism, excitability, conductivity, contractility), using analysis of electrocardiogram (ECG), stroke volume and mechanisms of their regulation. To interpret the function of the heart as a pump under evaluation of cardiac cycle duration, the structure of its phases and periods, stroke volume, blood pressure, blood pressure in the chambers of the heart and the aorta, and pulmonary artery, heart sounds. Analyze adjustable parameters of the heart as a pump and make a conclusion about the*

*mechanisms of its regulation. To analyze the basic parameters of blood circulation and to make a conclusion about state of blood vessels and regulatory mechanisms of the tone of arterial and venous vessels. To analyze the state of the vessels of microcirculation and to make a conclusion about the physiological mechanisms of fluid exchange at the level of blood and lymphatic capillaries. Explain features of regional circulation (coronary, cerebral, pulmonary, abdominal) and make a conclusion about the state of the blood vessels of these regions and their regulation. To analyze age-related changes in circulatory parameters and make a conclusion about the physiological properties of the heart as a pump, the function of blood vessels and mechanisms of regulation of circulation. To explain the physiological basis of research methods of circulation: stroke volume, venous blood pressure, heart rate, registration of ECG, phonocardiography (PCG), echocardiography, sphygmography.*

**Topic 14. General characteristics of cardiovascular system functions. Heart electrical activity and its physiological importance.**

The structure and functions of cardiovascular system

Physiological features of cardiac muscle

Automatism of the heart

The features of action potential of atypical cardiomyocytes

Conduction of excitation in different parts of the heart

The cardiac muscle excitation. Action potential of typical cardiomyocytes. Combination of excitation processes and contraction in cardiomyocytes

Changes in excitability of cardiomyocytes at excitation

The features of contractile heart function

**Topic 15. Electrocardiography – physiological basis.**

The concept of the method of electrocardiography.

Electrocardiographic deflections to the axis of the frontal and horizontal planes.

The main elements of the ECG and their origin.

Atrial ECG complex and its characteristics.

Ventricular ECG complex and its characteristics.

The electrical axis of the heart, determining its position.

Method of recording ECG in humans. Using ECG in the diagnosis of heart disease.

**Topic 16. The heart ejection function.**

Working cycles of heart.

Periods and phases of systole and diastole of the heart ventricles.

The valves of the heart and their significance. State of the heart valves during cardiac cycle.

Changes of the pressure in right and left ventricles during cardiac cycle.

Changes of volume of ventricles during systole and diastole.

**Topic 17. The regulation of the heart ejection function.**

Control of the heart pumping function. Myogenetic regulation of the heart.

Nervous intracardiac regulation of the heart.

The influence of the autonomic nervous system on the heart work. Autonomic cardiac reflexes.

Main subcortical centers of regulation of the heart. Influence of the cerebral cortex on the heart work.

The role of hormones in the regulation of heart activity.

Dependence of the heart's work on the ionic composition of blood.

Metabolism in the myocardium.

**Topic 18. The main laws of hemodynamic and its physiological interpretation.**

The functional characteristics of the vascular bed.

Blood pressure, factors that affect its level.

Linear and volume velocity of blood.

Types of blood flow in the vascular system. Reynold's number.

Blood viscosity and its impact on the blood flow in the vessels of different diameter.

The relationship between transmural pressure, vessel diameter and tension in their walls. (Laplace's law).

The influence of gravity on the hemodynamics.

Mechanisms of venous blood return to the heart.

#### **Topic 19. Physiology of microcirculation and venous system.**

The structure of the microcirculation bed.

Hydrodynamic conditions of blood flow in the capillaries.

Exchange processes in the capillaries. Starling's theory.

The physiological role of lymphodynamics.

Regulation of regional circulation

#### **Topic 20. Regulation of the systemic blood pressure.**

The myogenic regulation of the heart activity

The nervous intracardiac regulation of the heart work

The influence of autonomic nervous system on the heart work

The main subcortical centers of heart work regulation. The influence of the cortex on the heart work

The hormones role in heart work regulation

The dependence of the heart work from ionic blood composition

The metabolism in the myocardium

#### **Topic 21. Features of the regional hemodynamics. Hemodynamics in different functional states of the body.**

Physiological characteristics of regional circulation: pulmonary, coronary, cerebral, of the abdominal cavity. Age-related changes in circulatory system.

Features of blood flow during exercise, with changes in body position in space.

#### **Topic 22. Submodule – MCQs control №2 «Physiology of the circulation system».**

### **Submodule 11. The digestive system.**

#### ***Specific goals:***

*To interpret the concept of the digestive system and its regulatory mechanisms of physiological functions (secretory, motor, absorption). Evaluate the condition of the digestive system using parameters: hydrolysis of food substances, their speed of movement in the digestive canal, homeostasis parameters that reflect the processes of absorption. Making conclusions about the state of digestion in each part of the gastrointestinal tract that are based on the analysis of the secretory, motor, absorption functions and their regulation. To explain the physiological basis of modern research methods of secretory, motor, absorption function of the digestive system. To explain the mechanisms of hunger and saturation motivation using analysis of homeostatic indicators of nutrients in the blood.*

#### **Topic 23. General characteristics of the digestion. Digestion in the oral cavity.**

Functions and morphological features of the digestive system

The hormones of gastrointestinal tract

The mechanical digestion. The act of chewing

Swallow. Phases of swallowing

The physical and chemical properties of saliva and its functions

The regulation of salivation

#### **Topic 24. Digestion in the stomach.**

The functions of the stomach.

The composition and physico-chemical properties of gastric juice.

Enzymatic action of gastric juice. Role of hydrochloric acid of gastric juice in digestion.

Structural features of secretory glands of different parts of stomach.

Phases of gastric secretion and their characteristics. Dependence of gastric secretion on the nature of food.

Motor function of the stomach and its regulation.

**Topic 25. The role of the pancreas, liver and gallbladder in digestion.**

Composition and properties of pancreatic juice.

The enzymes of pancreatic juice and their impact on chyme.

Regulation of pancreatic secretion.

Functions of the liver.

The composition and properties of bile. The role of bile in digestion.

Regulation of secretion and excretion of bile.

**Topic 26. Digestion in the small and large intestine**

Overview of digestion in the small intestine. Absorption of nutrient, water and electrolytes.

The relationship between the hollow and membrane digestion.

Enzymatic and secretory function of the small intestine and its regulation.

Motor function of the small intestine and its regulation.

The role of the large intestine in digestion. The bacterial flora of the large intestine.

**Topic 27. Absorption processes. The systemic mechanisms of hunger and satiety.**

Absorption. Researchs methods. The absorption of substances in different parts of the alimentary canal and its mechanisms. Features of the absorption of water, salts, carbohydrates, proteins, fats.

**Topic 28. Regulation of the digestion. The systemic mechanisms of hunger and satiety.**

Regulation of absorption. Food motivation. Physiological basis of hunger and satiety.

**Submodule 12. The excretion system.*****Specific goals:***

*To interpret the concept of excretion system, mechanisms of regulation of homeostasis by analyzing the constants of homeostasis: volume blood, ion concentration, osmotic pressure, acid-base state. To make a conclusion about the state of the processes that underlie the formation of urine in the kidney using analysis of clearance (the rate of filtration in the glomeruli, reabsorption and secretion of substances and water in different parts of the nephron).*

*To analyze the function of kidney is using quantitative and qualitative composition of urine, its relative density depending on the dynamics of food and water regime. Analyze age-related features and functions of excretion system and mechanisms of their regulation. To explain the physiological basis of research methods of excretory function (determination of the glomerular filtration rate, processes of reabsorption and secretion of substances in the nephron, renal blood flo, the dynamics of daily diuresis and urine density).*

**Topic 29. The role of kidneys in excretion processes.**

The physiological role of the excretion processes in metabolism. The functions of the kidneys. Morphological and functional features of the kidneys. The structure of nephron. The features of kidneys blood supply

The general characteristics of urine formation

The glomerular filtration and its mechanisms

Clearance and its informative for urine formation processes valuation

**Topic 30. The urinary formation processes.**

Tubular reabsorption and its mechanisms.

Reabsorption of water and electrolytes in the distal nephron segment.

The mechanism of reabsorption in the loop of the nephron.

Tubular secretion and its physiological mechanisms.

Chemical composition and properties

Regulation of renal blood flow.

**Topic 31. The neuroendocrine mechanisms of urine formation regulation. Sweating**

Regulation of renal blood circulation.

Regulation of reabsorption of water and electrolytes in the distal nephron.

The incretory function of the kidneys. Renin-angiotensin system.

Mechanism of urination.

Excretory function of sweat and sebaceous glands and regulation of their activity.

**Topic 32. Submodule – MCQs control №3 «Physiology of the digestive and excretion system».**

**Submodule 13. Energy metabolism. Thermoregulation.**

**Specific goals:**

*Make conclusions about the intensity of metabolism under Analysis of energy costs which characterize the main exchange. Make a conclusion about the priority of oxidation of proteins, fats, carbohydrates during metabolism using respiratory rate. Make a conclusion about the mechanisms of regulation of metabolism intensity using analysis of the value of human basal metabolism. Make a conclusion about the daily energy expenditure of different professions and their compliance with the energy costs of food rations, needs of proteins, fats, and carbohydrates. To explain the physiological basis of methods of direct and indirect calorimetry. To analyze body temperature and to make a conclusion about the mechanisms of regulation of the balance between heat production and heat emission. To analyze the state of thermoregulation in humans under different conditions (depending on the physiological condition of the body, the temperature and humidity of the external environment) using body temperature and process of heat production and heat emission. Analyze age-related changes in thermoregulation in humans and its regulation. To explain the physiological basis of research methods of thermoregulation, thermometry, thermography, sweating.*

**Topic 33. Physiology of metabolism and energy exchange.**

The energy balance of the body and converting energy metabolism.

Basal metabolism and factors that determine it.

Work exchange of power. The energy consumption of the body at different types of work.

Sources of energy in the body. The caloric value of nutrients.

Specifically-dynamic performance nutrients.

Maintaining of the body weight and control of food intake.

**Topic 34. Energy balance. Thermoregulation and its mechanism.**

The physiological role of water and electrolytes. Regulation of water and electrolyte metabolism.

The physiological role of proteins, fats and carbohydrates.

Regulation of heat production and heat return from the body.

A functional system maintaining constant body temperature

**Topic 35. Module 2**

## 6.2 THE STRUCTURE OF THE SUBJECT

### Module 1 "General physiology"

Topic	Lectures	Laboratory classes	Individual students' work
<b>Submodule 1. Introduction to physiology</b>			
1. Introduction to physiology.	1	2	2
2. The main stages of physiology development. The history of physiology in the 19 <sup>th</sup> century. The physiological school in Ukraine.			2
<b>Submodule 2. Physiology of the excitable structures</b>			
3. Bioelectric occurrences on the membrane of excitable cells. Resting membrane potential and mechanisms of its	2	2	2

establishment. Action potential and its characteristics.			
4. Effects of continual current on excitable tissue. Main indicators of tissue's excitability.		2	2
5. Physiology of nerves. The mechanisms of excitation's conduction on nerves.		2	2
6. Physiology of synapses. The mechanism of synaptic transmission in excitatory and inhibitory synapses.	1	2	2
7. Physiology of the skeletal muscles.	1	2	2
8. Force and workload of muscles. Features of smooth muscle.	1	2	2
9. Submodule – MCQs control №1 «Physiology of excitable structures»		4	2
<b><i>Submodule 3. Nervous regulation of the body functions</i></b>			
10. General patterns of central nervous system work. Physiological features of neuronal circuits. Excitation in nerve centers.	1	2	2
11. Inhibitory processes in the nerve centers, their features and physiological role. Basic principles of coordination of reflex activity.	1	2	2
<b><i>Submodule 4. The role of the central nervous system in the regulation of motor functions.</i></b>			
12. The role of the nervous system in the regulation of motor functions of the body.	2	2	2
13. Physiology of the brainstem, the cerebellum and the diencephalon.			2
14. The role of the basal nuclei and the cerebral cortex in the regulation of motor functions of the body.		2	2
<b><i>Submodule 5. Physiology of the sensory system.</i></b>			
15. The sensory functions of the nervous system.	2	2	2
16. Pain and temperature sensation.		2	2
17. The visual analyzer.	2	2	2
18. Physiology of the ear and vestibular apparatus.		2	2
19. Physiology of taste, smell and interoceptive analyzer.		2	2
20. The physiology of the autonomic nervous system.		2	2
21. The influence of nervous system autonomic division on effector organs.		2	
22. Submodule – MCQs control №2 «Physiology of the nervous system. Sensory organs».		4	2
<b><i>Submodule 6. Humoral regulation and role of endocrine glands in regulation of the visceral functions</i></b>			
23. Type of humoral regulation of the body function and general patterns of hormones' action.	2	2	2
24. The endocrine function of thyroid and parathyroid glands, kidneys.		2	2

25. The endocrine function of hypothalamic-pituitary system and regulation of its secretion. The hormones of the adrenal medulla.		2	2
26. The endocrine function of the adrenal cortex.	2	2	2
27. General adaptation syndrome (stress).		2	
28. The endocrine function of the pancreas.		2	
29. The endocrine function of gonads, zona reticularis, placenta, epiphysis and thymus.		2	2
<b>Submodule 7. Physiological basis of behavior</b>			
30. The higher nervous activity (HNA). The physiological basis of behaviour.	2	2	2
31. The features of the human higher nervous activity.		2	
32. The role of motivations and emotions in behavior formation.		2	2
33. <b>Submodule – MCQs control №3</b> «Physiology of the endocrine system. Physiological basis of behaviour».		4	2
<b>Module 1</b>		2	4
<b>Total hours – 150</b>	<b>20</b>	<b>70</b>	<b>60</b>
<b>Credits ECTS – 5</b>			

## Module 2 "Physiology of visceral systems"

Topic	Lectures	Laboratory classes	Individual students' work
<b>Submodule 8. System of the blood.</b>			
1. Components and major functions of blood. Composition and functions of blood plasma.	2	2	2
2. Plasma proteins and physical and chemical properties of blood and plasma.		2	1
3. Erythrocytes. Erythropoiesis. Hemoglobin and its compounds.		2	1
4. The doctrine of blood group and Rh factor. Rules of transfusion.		2	1
5. Physiological features and functions of white blood cells. Diagnostic importance of leucogram.		2	1
6. Mechanisms of protection of cellular homeostasis of the organism.		2	1
7. Anticoagulation and coagulation of the blood system.		2	1

8. Acid-base homeostasis and mechanisms for its maintenance. Physiological mechanisms of the acid-base regulation.	2	2	1
9. Hematopoiesis and its regulation. Age-related changes in the blood system.			2
<b>Submodule 9. Respiratory system.</b>			
10. Morphofunctional characteristic of respiratory system	2	2	2
11. Lungs` ventilation mechanism.		2	1
12. Pulmonary and tissue gas exchange. Transport of respiratory gases by blood.	2	2	1
13. Regulation of respiration.		2	
14. Submodule – MCQs control №1 “Physiology of the blood and respiratory system”.		2	2
<b>Submodule 10. Circulatory system.</b>			
15. General characteristics of cardiovascular system functions. Heart electrical activity and its physiological importance.	2	2	2
16. Electrocardiography – physiological basis.		2	1
17. The heart ejection function.		2	2
18. The regulation of the heart ejection function.		2	2
19. The main laws of hemodynamic and its physiological interpretation.	2	2	2
20. Physiology of microcirculation and venous system.		2	2
21. Regulation of the systemic blood pressure		2	2
22. Features of the regional hemodynamic. Hemodynamic in different functional states of the body.		2	2
23. Submodule – MCQs control №2 «Physiology of the circulation system».		2	2
<b>Submodule 11. The digestive system.</b>			
24. General characteristics of the digestion. Digestion in the oral cavity.	2	2	2
25. Digestion in the stomach.		2	1
26. The role of the pancreas, liver and gallbladder in digestion.		2	1
27. Digestion in the small and large intestine.	2	2	2
28. Absorption processes. The systemic mechanisms of hunger and satiety.		2	2
29. Regulation of the digestion. The systemic mechanisms of hunger and satiety.		2	2
<b>Submodule 12. The excretion system.</b>			
30. The role of kidneys in excretion processes.	2	2	2
31. The urinary formation processes.		2	2
32. The neuroendocrine mechanisms of urine formation regulation. Sweating		2	2

33. Submodule – MCQs control №3 «Physiology of the digestive and excretion system».		2	2
<i><b>Submodule 13. Energy metabolism. Thermoregulation.</b></i>			
34. Physiology of metabolism and energy exchange.	2	2	2
35. Energy balance. Thermoregulation and its mechanism.		2	2
<b>36. Module 2</b>		2	4
<b>Total hours – 150</b>	<b>20</b>	<b>70</b>	<b>60</b>
<b>Credits ECTS – 5</b>			

### 6.3 THEMATIC PLAN OF THE LABORATORY CLASSES

#### Module 1

№	Topic	Number of hours
1.	Introduction to physiology	2 hours
2.	Bioelectric occurrences on the membrane of the excitable cells. Resting membrane potential and mechanisms of its establishment. Action potential and its characteristics.	2 hours
3.	Effects of continual current on excitable tissue. Main indicators of tissue's excitability.	2 hours
4.	Physiology of nerves. The mechanisms of excitation's conduction on nerves.	2 hours
5.	Physiology of synapses. The mechanism of synaptic transmission in excitatory and inhibitory synapses.	2 hours
6.	Physiology of skeletal muscles.	2 hours
7.	Force and workload of muscles. Features of smooth muscle.	2 hours
8.	<b>Submodule – MCQs control №1</b> «Physiology of excitable structures».	4 hours
9.	General patterns of central nervous system work. Physiological features of neuronal circuits. Excitation in nerve centers.	2 hours
10.	Inhibitory processes in the nerve centers, their features and physiological role. Basic principles of coordination of reflex activity.	2 hours
11.	The role of the nervous system in the regulation of motor functions of the body.	2 hours
12.	The role of the basal nuclei and the cerebral cortex in the regulation of motor functions of the body.	2 hours
13.	The sensory functions of the nervous system.	2 hours
14.	Pain and temperature sensation.	2 hours
15.	The visual analyzer.	2 hours
16.	Physiology of the ear and vestibular apparatus.	2 hours
17.	Physiology of taste, smell and interoceptive analyzer.	2 hours
18.	The physiology of the autonomic nervous system.	2 hours
19.	The influence of nervous system autonomic division on effector organs.	2 hours
20.	<b>Submodule – MCQs control №2</b> «Physiology of the nervous system. Sensory organs».	4 hours
21.	Type of humoral regulation of the body function and general patterns of hormones' action.	2 hours
22.	The endocrine function of thyroid and parathyroid glands, kidneys.	2 hours
23.	The endocrine function of hypothalamic-pituitary system and regulation of its secretion. The hormones of the adrenal medulla.	2 hours
24.	The endocrine function of the adrenal cortex.	2 hours
25.	General adaptation syndrome (stress).	2 hours
26.	The endocrine function of the pancreas.	2 hours
27.	The endocrine function of gonads, zona reticularis, placenta, epiphysis and thymus.	2 hours
28.	The higher nervous activity (HNA). The physiological basis of behavior.	2 hours
29.	The features of the human higher nervous activity.	2 hours
30.	The role of motivations and emotions in behavior formation.	2 hours
31.	<b>Submodule – MCQs control №3</b> «Physiology of the endocrine system. Physiological basis of behavior».	4 hours
32.	Module 1	<b>70 hours</b>

## Module 2

№	Topic	Number of hours
1.	Components and major functions of blood. Composition and functions of blood plasma.	2 hours
2.	Plasma proteins and physical and chemical properties of blood and plasma.	2 hours
3.	Erythrocytes. Erythropoiesis. Hemoglobin and its compounds.	2 hours
4.	The doctrine of blood group and Rh factor. Rules of transfusion.	2 hours
5.	Physiological features and functions of white blood cells. Diagnostic importance of leucogram.	2 hours
6.	Mechanisms of protection of cellular homeostasis of the organism.	2 hours
7.	Anticoagulation and coagulation of the blood system.	2 hours
8.	Acid-base homeostasis and mechanisms for its maintenance. Physiological mechanisms of the acid-base regulation.	2 hours
9.	Morphofunctional characteristic of respiratory system	2 hours
10.	Lungs` ventilation mechanism.	2 hours
11.	Pulmonary and tissue gas exchange. Transport of respiratory gases by blood.	2 hours
12.	Regulation of respiration.	2 hours
13.	<b>Submodule – MCQs control №1</b> “Physiology of the blood and respiratory system”.	2 hours
14.	General characteristics of cardiovascular system functions. Heart electrical activity and its physiological importance.	2 hours
15.	Electrocardiography – physiological basis.	2 hours
16.	The heart ejection function.	2 hours
17.	The regulation of the heart ejection function.	2 hours
18.	The main laws of hemodynamic and its physiological interpretation.	2 hours
19.	Physiology of microcirculation and venous system.	2 hours
20.	Regulation of the systemic blood pressure	2 hours
21.	Features of the regional hemodynamic. Hemodynamic in different functional states of the body.	2 hours
22.	<b>Submodule – MCQs control №2</b> «Physiology of the circulation system».	2 hours
23.	General characteristics of the digestion. Digestion in the oral cavity.	2 hours
24.	Digestion in the stomach. Regulation of the digestion in the oral cavity.	2 hours
25.	The role of the pancreas, liver and gallbladder in digestion.	2 hours
26.	Digestion in the small and large intestine.	2 hours
27.	Absorption processes. The systemic mechanisms of hunger and satiety.	2 hours
28.	Regulation of the digestion. The systemic mechanisms of hunger and satiety.	2 hours
29.	The role of kidneys in excretion processes.	2 hours
30.	The urinary formation processes.	2 hours
31.	The neuroendocrine mechanisms of urine formation regulation. Sweating	2 hours
32.	<b>Submodule – MCQs control №3</b> «Physiology of the digestive and excretion system».	2 hours
33.	Physiology of metabolism and energy exchange.	2 hours
34.	Energy balance. Thermoregulation and its mechanism.	2 hours
35.	Module 2	2 hours
	<b>Total</b>	<b>70 hours</b>

## 6.4 INDIVIDUAL WORK

### Module 1

№	Topic	Number of hours	Types of evaluation
1.	<b>Preparation for laboratory classes</b> - theoretical preparation and practical skills.	52	Current control on laboratory classes
2.	<b>Individual studying of topics which are not included in the plan of classes:</b>		Submodule
2.1	The main stages of physiology development. The history of physiology in the 19 <sup>th</sup> century. The physiological school in Ukraine.	2	
2.2	Physiology of the brainstem, the cerebellum and the diencephalon.	2	
3.	<i>Preparation for final module control</i>	4	Final module control
	<b>Total</b>	<b>60</b>	

### Module 2

№	Topic	Number of hours	Types of evaluation
1.	<b>Preparation for laboratory classes</b> - theoretical preparation and practical skills.	54	Current control on laboratory classes
2.	<b>Independent students work:</b>		Submodule
2.1	Hemathopoesis and its regulation. Age-related changes in the blood system.	2	
3.	<i>Preparation for final module control</i>	4	Final module control
	<b>Total</b>	<b>60</b>	

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

Technical means: curves for analysis (spiograms, cardiograms), CBC, urine 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

### Methodological software

1. Feketa V. General physiology. Module 1: methodological developments for laboratory classes / Feketa V., Kivezhdi K., Palamarchuk O., Patskun S., Nemesh M., Kostenchak-Svistack O. – [Електронний ресурс]: [Веб-сайт]. – Електронні дані. – Ужгород, 2018. – Режим доступу: <https://e-learn.uzhnu.edu.ua/course/view.php?id=1362>

2. Feketa V. Physiology of visceral systems. Module 2: methodological developments for laboratory classes / Feketa V., Kivezhdi K., Palamarchuk O., Patskun S., Nemesh M., Kostenchak-Svistack O. – [Електронний ресурс]: [Веб-сайт]. – Електронні дані. – Ужгород, 2014. – Режим доступу: <https://e-learn.uzhnu.edu.ua/course/view.php?id=1364>

**Recommended sources of literature****Basic**

1. Feketa V., Nemesh M., Palamarchuk O. Human physiology for doctors – ТОВ «НВП «Інтерсервіс»», м.Київ, 2019.-488р.
2. Feketa V. Course of lectures on physiology [Електронний ресурс]: [Веб-сайт]. – Електронні дані. – Ужгород, 2014. – Режим доступу: <https://e-learn.uzhnu.edu.ua/course/view.php?id=1367>
3. John E. Hall. Textbook of medical physiology: a South Asian Edition /John E. Hall, Arthur C. Guyton. – New Delhi: ELSEVIER, 2013. – 907 p.
4. K. Sembulingam. Essentials of Medical Physiology: textbook /K. Sembulingam, P. Sembulingam - New Delhi: Jaypee Brothers Medical Publishes, 2012. – 987 p.

**Additional**

1. Ganong W. Ganong`s Review of Medical Physiology: 24<sup>th</sup> edition/Ganong W., K.M. Barrett, S.M. Barman, S. Boitano, H. Brooks - San Francisco: McGraw-Hill Education, 2012. - 784 p.