

Handwritten signature

MINISTRY OF HEALTH OF UKRAINE
ODESA NATIONAL MEDICAL UNIVERSITY
Department of Medical Biology and Chemistry



CONFIRMED by

Vice rector for scientific and pedagogical work

Eduard BURIACHKIVSKYI

September 1st, 2024

WORKING PROGRAM IN THE DISCIPLINE
" FUNDAMENTALS OF CLINICAL BIOCHEMISTRY "

Level of higher education: second (master's degree)

Field of knowledge: 22 «Health care»

Specialty: 222 «Medicine»

Educational and professional program: Medicine

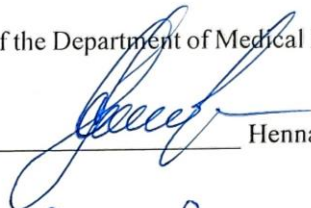
The working program is compiled on the basis of the educational and professional program "Medicine" for the training of specialists of the second (master's) level of higher education in the specialty 222 "Medicine" of the field of knowledge 22 "Health care", approved by the Academic Council of ONMedU (minutes No. 10 dated 27.06.2024).

Authors:

Head of the Department, PhD of Medical Sciences, Associate Professor Hennadii STEPANOV
 Senior teacher Alina KOSTINA
 PhD of Chemical Sciences, Associate Professor Ianina BURDINA
 PhD of Chemical Sciences, Associate Professor Alla GREKOVA
 PhD of Biological Sciences, Associate Professor Olha STORCHYLO
 PhD of Biological Sciences, Associate Professor Antonina VASILIEVA

The working program is approved at the meeting of the Department of Medical Biology and Chemistry
 Minutes No. 1 dated 26.08 2024.

Head of the department

 Hennadii STEPANOV

Approved by the guarantor of
 the educational and professional program

 Valeriia MARICHEREDA

Approved by the subject-cycle methodological commission for Biomedical Sciences of ONMedU
 Minutes No. 1 dated 27.08 2024

Head of the subject-cycle methodological commission for Biomedical Sciences of ONMedU
 Leonid GODLEVSKY

Revised and approved at the meeting of the Department of _____

Minutes No. dated / / 20 .

Head of the department

Revised and approved at the meeting of the Department of _____

Minutes No. dated / / 20 .

Head of the department

Revised and approved at the meeting of the Department of _____

Minutes No. dated / / 20 .

Head of the department

1. Description of the academic discipline:

Name of indicators	Field of knowledge, specialty, specialization, level of higher education	Characteristics of the academic discipline
Total number:	Branch of knowledge 22 "Health care"	<i>Full-time education</i> <i>Compulsory discipline</i>
Credits of ECTS: 3	Specialty 222 "Medicine"	<i>Year of training: 5</i>
Hours: 90	Level of higher education second (master's)	<i>Semesters IX</i>
Content modules: 1		<i>Lectures (0 hours)</i>
		<i>Seminars (0 hours)</i>
		<i>Practical (30 hours)</i>
		<i>Laboratory (0 hours)</i>
		<i>Independent work (60 hours)</i>
		<i>including individual tasks (0 hours)</i>
		<i>Form of final control- credit</i>

2. The purpose and tasks of the educational discipline, competences, program learning outcomes.

Goal: acquisition by students of knowledge and skills of practical work in the field of clinical biochemistry; substantiation of biochemical mechanisms of disease prevention and treatment and biochemical methods of disease diagnosis and control of treatment effectiveness.

Task: Expand the understanding of biochemical aspects of the normal course of metabolic processes in the human body. To provide basic information about changes and disorders that occur during diseases, in the biochemical composition of tissues, organs, systems and regulatory and functional mechanisms of the human body. To describe the normal biochemical status of a person, comparing possible pathochemical disorders with the norm. To learn and master methods of laboratory diagnostics used in clinical and biochemical practice.

The process of studying the discipline is aimed at forming elements of following competencies:

- **General competencies:**

- GC1. Ability to abstract thinking, analysis and synthesis
- GC 2. 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 7. Ability to work in a team
- GC 10. Ability to use information and communication technologies
- GC 11. Ability to search, process and analyze information from various sources
- GC 16. Ability to evaluate and ensure the quality of the work performed
- GC 17. Desire to preserve the environment

- **Special competencies are:**

- SC 2. Ability to determine the necessary list of laboratory and instrumental studies and evaluate their results
- SC 17. Ability to assess the impact of the environment, socio-economic and biological determinants on the state of health of an individual, family, population

SC 23. Ability to develop and implement scientific and applied projects in the field of health care

SC 24. Adherence to ethical principles when working with patients and laboratory animals

SC 25. Adherence to professional and academic integrity, being responsible for the reliability of the obtained scientific results

SC 28. Ability to apply fundamental biomedical knowledge at a level sufficient to perform professional tasks in the field of health care.

Program learning outcomes are:

PLO 1. Having a thorough knowledge of the structure of professional activity. Being able to carry out professional activities that require updating and integration of knowledge. To be responsible for professional development, the ability for further professional training with a high level of autonomy.

PLO 2. Understanding and knowledge of basic and clinical biomedical sciences, at a level sufficient for solving professional tasks in the field of health care.

PLO 3. Specialized conceptual knowledge that includes scientific achievements in the field of health care and is the basis for conducting research, critical understanding of problems in the field of medicine and related interdisciplinary problems, including the system of early intervention.

PLO 21. Searching for the necessary information in the professional literature and databases of other sources, analysing, evaluating and application of this information.

PLO 23. Assessment of the impact of the environment on human health to assess the morbidity of the population.

PLO 24. Organization of the necessary level of individual safety (own and the persons he cares for) in case of typical dangerous situations in the individual field of activity.

As a result of studying the academic discipline, the student of higher education must:

Know:

- general concepts of biochemical processes in the human body;
- understand the role of biochemical analyzes in the diagnosis of critical conditions and monitoring of critical conditions;
- modern diagnostic capabilities of laboratory research;
- features of the preanalytical stage of laboratory research;
- principles of laboratory research methods;
- rules for preparing patients for laboratory examination

Be able:

- analyze the state of the human body as a whole, using knowledge of the biochemical processes underlying their activity;
- predict the possibilities of the development of pathology, using knowledge about the biochemical mechanisms of their development;
- conduct basic biochemical research;
- interpret the results of the obtained biochemical studies, if necessary;
- select a range of adequate additional laboratory tests and compile diagnostic algorithms.

3. Content of the academic discipline

Content module 1.

Basics of clinical biochemistry

Topic 1. Introduction to clinical biochemistry. Pre-analytical stage of laboratory research.

Definition of clinical biochemistry. The main objects of clinical and biochemical research. Recommendations for blood sampling. Blood storage conditions. Basic principles of biochemical research. Use of whole blood for biochemical studies. Obtaining plasma and blood serum. Anticoagulants used in laboratory practice. The influence of various manipulations and drugs on the results of biochemical studies. General tactical principles of clinical biochemistry. Biochemical constellations. Modern methods of clinical biochemistry.

Topic 2. Basics of clinical enzymology (enzymodiagnostics, enzymopathies, enzymotherapy).

Subcellular localization and function of enzymes. Distribution of diagnostically important enzymes in the human body. Indicator enzymes. Isoenzymes. Methodical bases of enzyme activity determination. Enzymopathies: classification, mechanisms of development, biochemical manifestations. The cause of a pathological change in the activity profile of enzymes in the blood plasma. Clinical and diagnostic significance of determination of individual enzymes. Enzyme therapy. Enzymes, their activators and inhibitors as drugs.

Topic 3. Violation of carbohydrate metabolism. Pathobiochemistry of diabetes.

The biological role of carbohydrates in the human body. Biochemistry of carbohydrate metabolism. Biochemical methods of researching the level of glucose in the blood. Factors that ensure the correctness and reliability of laboratory research of glucose. Algorithms for diagnosing disorders of carbohydrate metabolism. Conditions for conducting a glycemic and glucosuric profile. Diabetes mellitus: etiology, pathogenesis, classification, clinical manifestations, laboratory diagnosis. Laboratory diagnosis of hypoglycemic states. Retrospective markers of hyperglycemia (glycosylated hemoglobin, fructosamine). Clinical and diagnostic significance of determination of C-peptide.

Topic 4. Disorders of lipid metabolism: atherosclerosis, dyslipoproteinemia, metabolic syndrome.

Clinical manifestations of lipid metabolism disorders. The main characteristic of lipoproteins. Properties and functions of apoproteins. Algorithm of laboratory diagnosis of disorders of lipid metabolism. Normal lipidogram. Classification of dyslipoproteinemias. Primary and secondary dyslipoproteinemias. Laboratory evaluation of the activity of the atherosclerotic process. Clinical and laboratory criteria of metabolic syndrome.

Topic 5. Violations of protein and nitrogen metabolism. Nitrogen balance in various pathological conditions.

Nitrogen balance in normal and pathological conditions. End products of nitrogen metabolism: ammonium salts and urea. The role of glutamine in the neutralization and transport of ammonia. Formation, causes of toxicity and neutralization of ammonia. Urea synthesis. Hyperammonemia. Activation of kidney glutaminase in acidosis. Violation of synthesis and excretion of urea.

Topic 6. Clinical biochemistry of the endocrine system.

Central nervous system and endocrine glands. Biochemistry of pituitary gonadotropic hormones Insulin. Thyroid hormones. Hormones of the medulla of the adrenal glands. Hormones of the adrenal cortex. Sex hormones.

Topic 7. Clinical biochemistry of vitamins.

General biological properties of vitamins. Classification and nomenclature of vitamins. Violation of the balance of vitamins in the body. The concept of antivitamins and provitamins.

The concept of vitamin-like substances (KoQ, (choline, pangamic acid, inositol, lipoic acid, vitamin U, carnitine and others). Water-soluble vitamins: biological role, daily need, food sources, hypovitaminosis. Fat-soluble vitamins: biological role, daily need, food sources, hypovitaminosis, hypervitaminosis.

Topic 8. Hormonal regulation of water-salt and phosphorus-calcium metabolism. Violation of water-salt exchange.

Pathochemistry of water-electrolyte exchange and the basis of KOS. Violation of electrolyte metabolism. Acidic - the main state in normal and pathological conditions. Water balance and its regulation in normal and pathological conditions. Biochemical mechanisms of regulation of phosphorus-calcium metabolism, disorders in pathology. Biochemical characteristics of the pathogenesis of rickets. Regulation of water-salt exchange. The structure and functions of aldosterone, atrial natriuretic factor vasopressin. Renin-angiotensin-aldosterone system. Biochemical mechanisms of renal hypertension, edema, xerostomia. The role of hormones in the regulation of calcium and phosphate metabolism (parathyroid hormone, calcitonin and calcitriol). Structure, biosynthesis and mechanism of action of calcitriol.

Topic 9. Clinical biochemistry of blood. Biochemistry of the system of hemostasis and fibrinolysis.

Clinical biochemistry of blood (chemical composition, constants, protein and non-protein substances). Pathobiochemistry of erythrocytes. Vascular-platelet and coagulation hemostasis. Components and factors of the blood coagulation system. Proteins are regulators of protease activity of blood coagulation factors. Activation of the blood clotting system. Inner and outer path. Anti-collision system. Biochemistry of hemostasis pathology. Hypo- and hypercoagulation. DVZ-syndrome. Activation of the blood coagulation system. Inner and outer path. Biochemistry of thrombin formation.

Topic 10. Biochemical study of blood plasma proteins and residual nitrogen. Clinical value of biochemical blood analysis.

Classification of blood plasma proteins. Physiological functions of albumins. Physiological functions of globulins. Metabolism of blood plasma proteins. Clinical value of total protein and proteinogram studies. Electrophoresis of blood serum proteins. Types of proteinograms. Causes of hypo- and hyperproteinemia. Dysproteinemia. Paraproteinemia. Proteins of the acute phase of inflammation. C-reactive protein in modern laboratory practice. Clinical and diagnostic significance of the study of individual blood plasma proteins. Residual nitrogen.

Topic 11. The exchange of porphyrins is normal and conditional. pathologies

Exchange of porphyrins is normal. Stages of heme biosynthesis. Pathology of porphyrin metabolism. Porphyrins: classification, pathogenesis, clinical manifestations, laboratory diagnostics. Laboratory indicators for some diseases and intoxications, which are accompanied by a violation of porphyrin metabolism.

Topic 12. The role of the liver in metabolism. Destruction of xenobiotics and biotransformation of medicinal substances. Pigment exchange in normal and pathological conditions.

Protein-synthesizing and detoxifying function of the liver. Metabolism of medicinal and foreign substances. Oxygen toxicity: formation of reactive oxygen species, their effect on lipids and other substances. Membrane damage due to lipid peroxidation. Mechanisms of protection against the toxic effect of oxygen - antioxidant systems: superoxide dismutase, catalase, glutathione peroxidase. Vitamin E and other antioxidants. Prooxidants. Hemoglobin metabolism. Metabolism of bilirubin. Violation of pigment exchange in parenchymal jaundice. Violation of

pigment exchange during mechanical jaundice. Violation of pigment exchange in hemolytic jaundice. Functional hyperbilirubinemias (pigmented hepatoses). Physiological jaundice of newborns.

Topic 13. Clinical value of biochemical analysis of urine. Collagenosis.

Clinical value of biochemical analysis of blood and urine. Determination of blood catalase and its diagnostic value. Oxyprolinuria in collagenoses. Creatinuria in muscular dystrophies and muscle denervation. Biochemical mechanisms of hyperuricemia, xanthinuria, orataciduria. Metabolism in renal tissue in pathological conditions. Changes in the properties and composition of urine in various diseases. Pathological components of urine. Determination of the content of glucose, protein, and ketone bodies in urine. Detection of blood, bile pigments and other path components in urine. Pathobiochemistry of connective tissue. Normal values of the main indicators that change in collagenoses.

Topic 14. Clinical biochemistry of inflammation and carcinogenesis.

Stages and key enzymes of inflammation. Chemical mediators of inflammation. Biological amines: formation, characteristics, biological effects, role in inflammation. Formation of eicosanoids: characteristics, biological effects, role in inflammation. The role of reactive forms of oxygen and nitrogen in inflammation. Acute phase proteins. Immunoglobulins. Cytokines. Modern biochemical markers in oncology. The concept of tumor markers. Classification of tumor markers. Criteria for an ideal tumor marker. Indications for determining tumor markers. Characteristics of individual tumor markers.

Topic 15. Final control of knowledge: assessment.

4. The structure of the academic discipline

Names of topics	Number of hours					
	That's all	including				
		lectures	seminars	practical	laboratory	SRS
Content module 1.						
Metabolic transformations in the body during pathology						
Topic 1. Introduction to clinical biochemistry. Pre-analytical stage of laboratory research.	6	0	0	2	0	4
Topic 2. Basics of clinical enzymology (enzymodiagnosis, enzymopathies, enzymotherapy).	6	0	0	2	0	4
Topic 3. Disorders of carbohydrate metabolism. Pathobiochemistry of diabetes.	6	0	0	2	0	4
Topic 4. Disorders of lipid metabolism: atherosclerosis, dyslipoproteinemia, metabolic syndrome.	6	0	0	2	0	4
Topic 5. Violations of	6	0	0	2	0	4

protein and nitrogen metabolism. Nitrogen balance in various pathological conditions.						
Topic 6. Clinical biochemistry of the endocrine system.	6	0	0	2	0	4
Topic 7. Clinical biochemistry of vitamins.	6	0	0	2	0	4
Topic 8. Hormonal regulation of water-salt and phosphorus-calcium metabolism. Violation of water-salt exchange.	6	0	0	2	0	4
Topic 9. Clinical biochemistry of blood. Biochemistry of the system of hemostasis and fibrinolysis.	6	0	0	2	0	4
Topic 10. Biochemical study of blood plasma proteins and residual nitrogen. Clinical value of biochemical blood analysis.	6	0	0	2	0	4
Topic 11. Exchange of porphyrins in normal and pathological conditions	6	0	0	2	0	4
Topic 12. The role of the liver in metabolism. Destruction of xenobiotics and biotransformation of medicinal substances. Pigment exchange in normal and pathological conditions.	6	0	0	2	0	4
Topic 13. Clinical value of biochemical analysis of urine. Collagenosis.	6	0	0	2	0	4
Topic 14. Clinical biochemistry of inflammation and carcinogenesis	6	0	0	2	0	4
<i>Together according to content module 1</i>	48	0	0	16	0	32

Final control of knowledge: credit.	6	0	0	2	0	4
<i>Individual tasks</i>	0	0	0	0	0	0
Only hours	90	0	0	30	0	60

5. Topics of lectures / seminars / practical / laboratory classes

5.1. Topics of lectures

Lectures are not provided.

5.2. Topics of seminar classes

Seminar classes are not provided.

5.3. Topics of practical classes

No	Topic name	How many hours?
1.	Topic 1. Practical lesson 1. Definition of clinical biochemistry. The main objects of clinical and biochemical research. Recommendations for blood sampling. Blood storage conditions. Basic principles of biochemical research. Use of whole blood for biochemical studies. Obtaining plasma and blood serum. Anticoagulants used in laboratory practice. The influence of various manipulations and drugs on the results of biochemical studies. General tactical principles of clinical biochemistry. Biochemical constellations. Modern methods of clinical biochemistry.	2
2.	Topic 2. Practical lesson 2. Subcellular localization and function of enzymes. Distribution of diagnostically important enzymes in the human body. Indicator enzymes. Isoenzymes. Methodical bases of enzyme activity determination. Enzymopathies: classification, mechanisms of development, biochemical manifestations. The cause of a pathological change in the activity profile of enzymes in the blood plasma. Clinical and diagnostic significance of determination of individual enzymes. Enzyme therapy. Enzymes, their activators and inhibitors as drugs.	2
3.	Topic 3. Practical lesson 3. The biological role of carbohydrates in the human body. Biochemistry of carbohydrate metabolism. Biochemical methods of researching the level of glucose in the blood. Factors that ensure the correctness and reliability of laboratory research of glucose. Algorithms for diagnosing disorders of carbohydrate metabolism. Conditions for conducting a glycemic and glucosuric profile. Diabetes mellitus: etiology, pathogenesis, classification, clinical manifestations, laboratory diagnosis. Laboratory diagnosis of hypoglycemic states. Retrospective markers of hyperglycemia (glycosylated hemoglobin, fructosamine). Clinical and diagnostic significance of determination of C-peptide.	2
4.	Topic 4. Practical lesson 4. Clinical manifestations of lipid metabolism disorders. The main characteristic of lipoproteins. Properties and functions of apoproteins. Algorithm of laboratory diagnosis of disorders of lipid metabolism. Normal lipidogram.	2

	Classification of dyslipoproteinemias. Primary and secondary dyslipoproteinemias. Laboratory evaluation of the activity of the atherosclerotic process. Clinical and laboratory criteria of metabolic syndrome.	
5.	Topic 5. Practical lesson 5. Nitrogen balance in normal and pathological conditions. End products of nitrogen metabolism: ammonium salts and urea. The role of glutamine in the neutralization and transport of ammonia. Formation, causes of toxicity and neutralization of ammonia. Urea synthesis. Hyperammonemia. Activation of kidney glutaminase in acidosis. Violation of synthesis and excretion of urea.	2
6.	Topic 6. Practical lesson 6. Central nervous system and endocrine glands. Biochemistry of pituitary gonadotropic hormones Insulin. Thyroid hormones. Hormones of the medulla of the adrenal glands. Hormones of the adrenal cortex. Sex hormones.	2
7.	Topic 7. Practical lesson 7. General biological properties of vitamins. Classification and nomenclature of vitamins. Violation of the balance of vitamins in the body. The concept of antivitamin and provitamin. The concept of vitamin-like substances (KoQ, (choline, pangamic acid, inositol, lipoic acid, vitamin U, carnitine and others). Water-soluble vitamins: biological role, daily need, food sources, hypovitaminosis. Fat-soluble vitamins: biological role, daily need, food sources, hypovitaminosis, hypervitaminosis.	2
8.	Topic 8. Practical lesson 8. Pathochemistry of water-electrolyte exchange and the basis of KOS. Violation of electrolyte metabolism. Acidic - the main state in normal and pathological conditions. Water balance and its regulation in normal and pathological conditions. Biochemical mechanisms of regulation of phosphorus-calcium metabolism, disorders in pathology. Biochemical characteristics of the pathogenesis of rickets. Regulation of water-salt exchange. The structure and functions of aldosterone, atrial natriuretic factor vasopressin. Renin-angiotensin-aldosterone system. Biochemical mechanisms of renal hypertension, edema, xerostomia. The role of hormones in the regulation of calcium and phosphate metabolism (parathyroid hormone, calcitonin and calcitriol). Structure, biosynthesis and mechanism of action of calcitriol.	2
9.	Topic 9. Practical lesson 9. Clinical biochemistry of blood (chemical composition, constants, protein and non-protein substances). Pathobiochemistry of erythrocytes. Vascular-platelet and coagulation hemostasis. Components and factors of the blood coagulation system. Proteins are regulators of protease activity of blood coagulation factors. Activation of the blood clotting system. Inner and outer path. Anti-collision system. Biochemistry of hemostasis pathology. Hypo- and hypercoagulation. DVZ-syndrome. Activation of the blood coagulation system. Inner and outer path. Biochemistry of thrombin formation.	2
10.	Topic 10. Practical lesson 10. Classification of blood plasma proteins. Physiological functions of albumins. Physiological functions of globulins. Metabolism of blood plasma proteins. Clinical value of total protein and proteinogram studies. Electrophoresis of blood serum proteins. Types of proteinograms. Causes of hypo- and hyperproteinemia. Dysproteinemia. Paraproteinemia. Proteins of the acute phase of inflammation. C-reactive protein in modern laboratory practice. Clinical and diagnostic significance of the study of individual blood plasma proteins. Residual nitrogen.	2

11.	Topic 11. Practical lesson 11. Exchange of porphyrins is normal. Stages of heme biosynthesis. Pathology of porphyrin metabolism. Porphyrins: classification, pathogenesis, clinical manifestations, laboratory diagnostics. Laboratory indicators for some diseases and intoxications, which are accompanied by a violation of porphyrin metabolism.	2
12.	Topic 12. Practical lesson 12. Protein-synthesizing and detoxifying function of the liver. Metabolism of medicinal and foreign substances. Oxygen toxicity: formation of reactive oxygen species, their effect on lipids and other substances. Membrane damage due to lipid peroxidation. Mechanisms of protection against the toxic effect of oxygen - antioxidant systems: superoxide dismutase, catalase, glutathione peroxidase. Vitamin E and other antioxidants. Prooxidants. Hemoglobin metabolism. Metabolism of bilirubin. Violation of pigment exchange in parenchymal jaundice. Violation of pigment exchange during mechanical jaundice. Violation of pigment exchange in hemolytic jaundice. Functional hyperbilirubinemias (pigmented hepatoses). Physiological jaundice of newborns.	2
13.	Topic 13. Practical lesson 13. Clinical value of biochemical analysis of blood and urine. Determination of blood catalase and its diagnostic value. Oxyprolinuria in collagenoses. Creatinuria in muscular dystrophies and muscle denervation. Biochemical mechanisms of hyperuricemia, xanthinuria, orataciduria. Metabolism in renal tissue in pathological conditions. Changes in the properties and composition of urine in various diseases. Pathological components of urine. Determination of the content of glucose, protein, and ketone bodies in urine. Detection of blood, bile pigments and other path components in urine. Pathobiochemistry of connective tissue. Normal values of the main indicators that change in collagenoses.	2
14.	Topic 14. Practical lesson 14. Stages and key enzymes of inflammation. Chemical mediators of inflammation. Biological amines: formation, characteristics, biological effects, role in inflammation. Formation of eicosanoids: characteristics, biological effects, role in inflammation. The role of reactive forms of oxygen and nitrogen in inflammation. Acute phase proteins. Immunoglobulins. Cytokines. Modern biochemical markers in oncology. The concept of tumor markers. Classification of tumor markers. Criteria for an ideal tumor marker. Indications for determining tumor markers. Characteristics of individual tumor markers.	2
15.	Practical lesson 15. Final control of knowledge: credit.	2
	Together	30

5.4. Topics of laboratory classes

Laboratory classes are not provided.

6. Independent work of a student of higher education

No	Title of the topic / types of tasks	How many hours?
----	-------------------------------------	-----------------

1.	Topic 1. Preparation for practical lesson 1	4
2.	Topic 2. Preparation for practical class 2	4
3.	Topic 3. Preparation for practical class 3	4
4.	Topic 4. Preparation for practical class 4	4
5.	Topic 5. Preparation for practical class 5	4
6.	Topic 6. Preparation for practical lesson 6	4
7.	Topic 7. Preparation for practical lesson 7	4
8.	Topic 8. Preparation for practical class 8	4
9.	Topic 9. Preparation for practical lesson 9	4
10.	Topic 10. Preparation for practical lesson 10	4
11.	Topic 11. Preparation for practical class 11	4
12.	Topic 12. Preparation for practical lesson 12	4
13.	Topic 13. Preparation for practical lesson 13	4
14.	Topic 14. Preparation for practical lesson 14	4
15.	Preparation for practical class 15	4
	Together	60

7. Teaching methods

Practical training: conversation, discussion of problem situations, role-playing games, practical works; solving situational problems clinical tasks, drawing up graphic schemes, writing tasks, individual control interview.

Independent work: independent work with recommended basic and additional literature, with electronic information resources.

8. Forms of control and assessment methods (including criteria for evaluating learning outcomes)

Current control: oral survey, testing, control of learning practical skills, solving situational clinical tasks, assessment of activity in class.

Final control: credit

Credit is carried out in the last class after the end of the practical classes before the beginning of the examination session

The structure of the current assessment in the practical session:

- Evaluation of theoretical knowledge on the subject of the lesson:
 - methods: survey, written work, solving a situational problem, solving test problems;
 - the maximum score is 5, the minimum score is 3, the unsatisfactory score is 2.
- Assessment of the acquisition of practical skills:
 - methods: methods: survey, solving a situational problem, solving test problems.

Current assessment criteria for practical training:

"5"	The acquirer is fluent in the material, takes an active part in discussing and solving the situational problem, knows how to determine the main biochemical indicators in biological objects and give them a medical (medical-biological) assessment.
"4"	The acquirer has a good command of the material, takes part in the discussion and solution of the situational problem, knows how to determine the main biochemical indicators in biological objects and give them a medical and biological assessment, but allows some insignificant mistakes (inaccuracies) in answering questions.

"3"	The acquirer does not have sufficient knowledge of the material, takes part in the discussion and solution of the situational problem without confidence, makes mistakes when explaining the laws of human metabolism.
"2"	The acquirer does not know the material, does not take part in the discussion and solution of the situational clinical problem, has significant gaps in the knowledge of the program material, makes fundamental mistakes when explaining the laws of human metabolism, does not have the necessary practical skills.

Credit is given to the applicant who completed all tasks of the work program of the academic discipline, took an active part in practical classes, completed and defended an individual assignment and has an average current grade of at least 3.0 and has no academic debt.

Test is carried out: at the last lesson before the beginning of the examination session - with the tape system of learning, at the last lesson - with the cyclical system of learning. The credit score is the arithmetic mean of all components on a traditional four-point scale and has a value that is rounded using the statistical method with two decimal places after the decimal point.

9. Distribution of points received by applicants of higher education

The obtained average score for the academic discipline for applicants who have successfully mastered the work program of the academic discipline is converted from a traditional four-point scale to points on a 200-point scale, as shown in the table:

Conversion table of a traditional assessment into a multi-point scale

Traditional four-point scale	Multipoint 200-point scale
Excellent ("5")	185 - 200
Good ("4")	151 - 184
Satisfactory ("3")	120-150
Unsatisfactory ("2")	Below 120

A multi-point scale (200-point scale) characterizes the actual success of each applicant in learning the educational component. The conversion of the traditional grade (average score for the academic discipline) into a 200-point grade is performed by the information and technical department of the University.

According to the obtained points on a 200-point scale, the achievements of the applicants are evaluated according to the ECTS rating scale. Further ranking according to the ECTS rating scale allows you to evaluate the achievements of applicants from the educational component who are studying in the same course of the same specialty, according to the points they received.

The ECTS scale is a relative-comparative rating, which establishes the applicant's belonging to the group of better or worse among the reference group of fellow applicants (faculty, specialty). An "A" grade on the ECTS scale cannot be equal to an "excellent" grade, a "B" grade to a "good" grade, etc. When converting from a multi-point scale, the limits of grades "A", "B", "C", "D", "E" according to the ECTS scale do not coincide with the limits of grades "5", "4", "3" according to the traditional scale. Acquirers who have received grades of "FX" and "F" ("2") are not included in the list of ranked acquirers. The grade "FX" is awarded to applicants who have obtained the minimum number of points for the current learning activity, but who have not passed the final examination. A grade of "F" is assigned to applicants who have attended all classes in the discipline, but have not achieved a grade point average (3.00) for the current academic activity and are not admitted to the final examination.

Applicants who study in one course (one specialty), based on the number of points scored in the discipline, are ranked on the ECTS scale as follows:

Conversion of the traditional grade from the discipline and the sum of points on the ECTS

scale

Evaluation on the ECTS scale	Statistical indicator
A	Top 10% achievers
B	The next 25% of earners
C	The next 30% of earners
D	The next 25% of earners
E	The next 10% of earners

10. Methodological support

- Working program in the discipline
- Syllabus
- Methodological recommendations for the practical classes in the discipline
- Methodological recommendations for the individual work of higher education applicants
- Multimedia presentations
- Situational tasks
- Tests on the theme

11. Questions for preparing for the final control

- Creation of schemes: mechanism of digestion in different parts of the gastrointestinal tract.
- Creation of schemes: the content of necessary substances in the daily diet;
- Create a scheme: nutritional features, depending on blood groups.
- Create a scheme: causes contributing to the development of diseases of the digestive organs.
- Create a scheme: types of detoxification and body cleansing systems.
- Create a scheme: principles of rational nutrition.

12. Recommended literature

1. Gubsky Yu.I., I.V. Nizhenkovska, Korda M.M. Biological and Bioorganic Chemistry: in 2 books. Book 2. Biological Chemistry: textbook. 2021. 544 p.
2. Satyanarayana U. Biochemistry. 5th edition. India 2020. 777 p.
3. Lehninger. Principles of Biochemistry. 7th edition. NY, United States. 2017.
4. Jeremy M. Berg, John L. Tymoczko, Gregory J. Gatto. Biochemistry. 8th Revised edition. 2015.
5. Lippincott Illustrated Reviews: Biochemistry. Philadelphia :Wolters Kluwer, 2017. 560 p.
6. Baynes J., Dominiczak M. Medical Biochemistry. 5th Edition. Elsevier, 2018. 712 p.
7. Olivia Vanbergen, Gareth Wintle, Marek H. Dominiczak. Crash Course Metabolism and Nutrition. 5th Edition. Elsevier. 2019.
8. Carol Byrd-Bredbenner. Wardlaw's Perspectives in Nutrition 11 Edition. McGraw-Hill Education. 2019.

13. Electronic information resources

1. <https://info.odmu.edu.ua/chair/biology/> - materials of the Department of Medical Biology and Chemistry
2. <http://libblog.odmu.edu.ua/> - ONMedU library
3. <https://moodle.odmu.edu.ua/login/index.php> - system of electronic testing and electronic journal of ONMedU

4. <http://moz.gov.ua> – Ministry of Health of Ukraine
5. www.who.int – World Health Organization
6. www.dec.gov.ua/mtd/home/ - State Expert Center of the Ministry of Health of Ukraine
7. <http://bma.org.uk> – British Medical Association
8. www.gmc-uk.org - General Medical Council (GMC)
9. www.bundesaerztekammer.de – German Medical Association