MINISTRY OF HEALTH OF UKRAINE

KHARKIV NATIONAL MEDICAL UNIVERSITY

**Department of Biochemistry**

2024-2025

# SYLLABUS OF EDUCATION COMPONENT

# BIOLOGICAL CHEMISTRY

**Normative educational component**

| | |
|---|---|
| Format of education | full-time |
| Field of knowledge | 22 “Healthcare”<br>(code and title of discipline) |
| Specialty | 223 “Nursing”<br>(code and title of discipline) |
| Education-professional programme | “Nursing”<br>first (Bachelor) level<br>higher education<br>(four years of study) |
| Course | Four |

Approved by the Department of Biochemistry

Protocol #20
d.d. August 28, 2020

Завідувач кафедри
_____ Наконечна О.А.

Approved by the Methodical Commission of KhNMU on problems of natural and scientific training

Protocol #___8
d.d. _August 28, 2020

Голова
_____ Вовк О.Ю.

## COMPONENT DEVELOPERS OF THE SYLLABUS


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## DATA ON TEACHERS TEACHING THE EDUCATIONAL COMPONENT

| | |
|---|---|
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# INTRODUCTION

**The syllabus of the educational component** "Biological Chemistry" is compiled in accordance with the Educational and Professional Program (hereinafter referred to as "Nursing") and the Standard of Higher Education of Ukraine (hereinafter referred to as the Standard) first (bachelor's) level, fields of knowledge 22 "Health Care" specialty 223 "Nursing".

**Description of the educational component (abstract):** the educational component "Biological Chemistry" is taught to students of the fourth year of education during one semester. 3.0 ECTS credits are assigned to the study of the educational component - 90 hours (40 classroom hours and 50 hours of independent work). The program of the educational component is structured into two sections.

**The subject of study of the educational component** is the chemical composition of the human body and the biochemical transformations to which the molecules that make up their composition are subjected.

**Interdisciplinary relationships**: biological chemistry as an educational discipline:

a) is based on the study of medical biology, biophysics, medical chemistry, morphological disciplines and integrates with these disciplines;

b) provides the basis for students to study molecular biology, genetics, physiology, pathology, general and molecular pharmacology, toxicology and propaedeutics of clinical disciplines, which involves the integration of teaching these disciplines and the formation of abilities to apply knowledge of biological chemistry, primarily biochemical processes taking place in the body of healthy and ill individuals in the process of further education and professional activity;

c) underlies the clinical diagnosis of the most common diseases, monitoring the course of the disease, monitoring the effectiveness of treatment and measures aimed at preventing pathological processes;

**Prerequisites.** The study of the discipline involves the prior mastering of disciplines in medical biology, biophysics, medical and bioorganic chemistry, morphological disciplines.

**Postrequisites.** The main provisions of the discipline should be applied in the study of related disciplines during the next years of study, is the basis for preparation for the licensing exam EDKI, preparation for study in higher education institutions in the programs of the third educational and scientific level of higher education.

**Discipline page in Moodle system:**

http://distance.knmu.edu.ua/course/view.php?id=2562

## 1. AIM AND TASKS OF THE DISCIPLINE

**1.1. The aim** of teaching the discipline "Biological chemistry" is a systematic study of the chemical composition, structural organization and properties of bioorganic compounds, which are components of cells, tissues and organs of the human body, patterns of metabolism and energy at the molecular level in healthy and diseased organisms and the formation on this basis biochemically - the scientific thinking

necessary for successful training of specialists who possess a considerable volume of theoretical and practical knowledge concerning the chemical bases of life: chemical composition of organic compounds and the nature of metabolic processes occurring in the human body and provision of theoretical basis for the study of other medical and biological disciplines.

**1.2 The main tasks** of studying the discipline "Biological Chemistry" are: to find out features of metabolic transformations in living organisms; to acquire knowledge of hallmarks of protein, nucleic acid, carbohydrate, lipid, enzyme, vitamin, hormone synthesis; to master the basic catabolic cycles of bioorganic molecules; to study the main regulatory mechanisms that carry out the integration of all metabolic pathways for the transformation of bioorganic molecules; to give students an idea of modern trends and directions of fundamental-scientific and applied researches in biochemistry and related sciences for future professional orientation.

**1.3 Competences and results of training** whose formation is facilitated by the discipline (interconnection with the normative content of the training of higher education graduates formulated in terms of the results of training in the Standard).

**1.3.1.** According to the requirements of the Standard, the discipline ensures acquisition of the following **competences**:

- *integral*: the ability to solve typical and complex specialized tasks and practical problems in the professional activity or in the process of learning, apply the acquired knowledge, skills, abilities and personal qualities, values to perform the task of any level of complexity during professional activity or training.

- *general*: the ability to apply knowledge in practical situations; knowledge and understanding of the subject and understanding of the profession; ability to self-regulate and lead a healthy lifestyle, ability to adapt and act in a new situation; ability to choose communication strategy; ability to work in a team; interpersonal skills; ability to speak native language both orally and in writing; ability to speak second language; skills of using information and communication technologies; ability to abstract thinking, analysis and synthesis, ability to learn and be modernly trained; ability to apply knowledge in practical situations; ability to evaluate and ensure the quality of work performed; determination and persistence in terms of tasks and responsibilities; ability to act socially responsibly and socially consciously; the desire to preserve the environment.

- *special (professional)*: the ability to recognize and interpret signs of health and its changes, illness or disability (assessment/diagnosis), restrictions on the possibility of full-fledged life activities and to determine the problems of patients with various diseases and conditions; application of professional skills (skills), medical devices, interventions and actions to provide the patient/client with dignified treatment, privacy (intimacy), confidentiality, protection of his rights, physical, psychological and spiritual needs on the basis of transcultural nursing, tolerant and non-judgmental behavior; the ability to effectively apply a set of nursing skills (skills), medical devices, interventions and actions to provide care based on a holistic approach, taking into account the satisfaction of the patient's needs for comfort, nutrition, personal hygiene and the ability of the person to meet his daily needs; the ability to effectively apply a set of professional skills (skills), medical devices, interventions and actions in assessing the functional state of patients/clients, preparing them for diagnostic studies and taking

biological material for laboratory studies; the ability to organize the provision of medical care according to the principle of family medicine.

**1.3.2** The study of the discipline provides students with the acquisition of the following **program learning outcomes**:

PLO 12. It is necessary to perform medical manipulations in order to take measures to stabilize the functional state of the body.

PLO 14. Be able to prepare the patient, collect and direct biological material for laboratory and instrumental research.

**1.3.3.** The study of the educational component ensures that students acquire the following social skills (soft skills): communication (implemented through: the method of working in groups and brainstorming during the analysis of biochemical cases, the method of presenting the results of independent work and defending them in a group); teamwork (implemented through: the method of working in groups and brainstorming during the analysis of biochemical cases); conflict management (implemented through: business games); time management (implemented through: self-organization method during classroom work in groups and independent work); leadership skills (the method of presenting the results of independent work and defending them in a group).

## 2. INFORMATIONAL VOLUME OF DISCIPLINE

<table>
<tr><td rowspan="2">Parameters</td><td rowspan="2">Field of knowledge, specialty, educational and qualification level, EPP</td><td>Characteristics of discipline</td></tr>
<tr><td>Full day courses</td></tr>
<tr><td>Number of credits 3.0</td><td>Field of knowledge<br>22 ‘Healthcare’<br>(шифр і назва)</td><td>Normative</td></tr>
<tr><td rowspan="5">Total number of hours – 90</td><td rowspan="5">Specialty<br>223 ‘Nursing’<br>(шифр і назва)</td><td>Course:</td></tr>
<tr><td>4</td></tr>
<tr><td>Semester</td></tr>
<tr><td>8</td></tr>
<tr><td>Lectures</td></tr>
<tr><td rowspan="6">Hours for full day (or part-time evening) courses:<br>practical – 40<br>Self-study – 50</td><td rowspan="6">Educational degree:<br>first (undergraduate)<br>EPP:<br>"Nursing"</td><td>20 hours</td></tr>
<tr><td>Practical classes, seminars</td></tr>
<tr><td>20 hours</td></tr>
<tr><td>Self-study</td></tr>
<tr><td>50 hours</td></tr>
<tr><td>Control type:<br>Differential calculation</td></tr>
</table>

## 2.1 Subject description

### 2.2.1 Lecture topics

| № | Titles | Number of hours | Types of lectures |
|---|---|---|---|
| 1. | Introduction to biochemistry. Biochemistry of enzymes. | 2 | |
| 2. | General characteristics of vitamins. Fat-soluble and water-soluble vitamins. Vitamin-like substances. Antivitamins. | 2 | |
| 3. | Bioenergetic processes: biological oxidation, oxidative phosphorylation, ATP synthesis. Basic features of metabolism regulation. Common catabolic pathways: pyruvate oxidative decarboxylation, tricarboxylic acid cycle. | 2 | |
| 4. | Biochemistry of hormones. | 2 | |
| 5. | Carbohydrate metabolism. Regulation. Violation. | 2 | |
| 6. | Lipid metabolism. Regulation. Violation. | 2 | |
| 7. | | 2 | |
| 8. | Functions and metabolism of nucleotides, its possible disorders. | 2 | |
| 9. | Blood biochemistry. Biochemistry of erythrocytes. Water-salt and mineral exchange. | 2 | |
| 10. | Deamination and transamination of amino acids. Ammonia metabolism. Specific metabolism of amino acids. | 2 | |
| 11. | Biochemistry of kidneys and urine. Biochemistry of the nervous system, muscles and connective tissue. | 2 | Informational (thematic) |
| **Total number of hours** | | **20** | |

### 2.2.2 Topics of seminars

Not included in the curriculum.

### 2.2.3 Topics of practical classes

| № | Titles | Number of hours | Learning methods | Forms of control |
|---|---|---|---|---|
| Chapter 1. General patterns of metabolism. Biochemistry of hormones. Metabolism of carbohydrates and lipids. | | | | |
| 1. | Introduction to biochemistry. Development of biochemistry as a science. Biochemical components of the cell. Safety rules in biochemical laboratory. | 2 | Verbal (lecture, conversation), visual (illustration), practical (independent work, case-method, | |
| 2. | General characteristics of vitamins. Fat-soluble vitamins. Vitamin-like substances. Antivitamins. Water-soluble vitamins. Bioenergetic processes: biological oxidation, oxidative phosphorylation, ATP synthesis. | 2 | | |
| 3. | General characteristics of hormones. Hormones of the hypothalamic-pituitary system. Protein-peptide hormones and | 2 | | |

| | | | | |
|---|---|---|---|---|
| | amino acid derivatives. Steroid hormones. | | brainstorming, pair work, group work, test tasks).. | Oral examination (individual and frontal); written survey; test control. |
| 4. | Digestion and absorption of carbohydrates. Glycogen exchange. Glycolysis. Gluconeogenesis. Pentose phosphate pathway of glucose oxidation. Regulation and disturbance of carbohydrate metabolism. | 2 | | |
| 5. | Digestion and absorption of lipids. Resynthesis of triacylglycerols in the intestines. Exchange of triacylglycerols and phospholipids. Metabolism of higher fatty acids. Exchange of ketone bodies, glycerol and cholesterol. Regulation and disorders of lipid metabolism. | 4 | | |
| 6. | Final control work for section 1. | 1 | | |
| Chapter 2. Metabolism of proteins and nucleic acids. Functional biochemistry. | | | | |
| 7. | Digestion and absorption of proteins. General ways of conversion of amino acids. | 2 | Verbal (lecture, conversation), visual (illustration), practical (independent work, case-method, brainstorming, pair work, group work, test tasks).. | Oral examination (individual and frontal); written survey; test control. |
| 8. | Ammonia metabolism. Specific metabolism of amino acids. | 2 | | |
| 9. | Functions and metabolism of nucleotides. Regulation and violation. Biochemistry of blood and erythrocytes. | 2 | | |
| 10. | Water-salt and mineral metabolism. Biochemistry of kidneys and urine. | 1 | | |
| 11. | Biochemistry of the nervous system, muscles and connective tissue. | 1 | | |
| 12. | Final control work for section 2. | 0,5 | | |
| 13. | Differentiated scoring | 0,5 | | |
| | **Total number of hours** | 20 | | |
| | | | | |

### 2.2.4 Topics of laboratory works

Not included in the curriculum.

### 2.2.5 Self-study

| № з/п | Topics | Number of hours | Learning methods | Forms of control |
|---|---|---|---|---|
| ***Part 1. General principles of metabolism.*** | | | | |
| 1. | ***Topic 1***. Connection of biochemistry with other medical and biological sciences. Clinical biochemistry. Biochemical laboratory diagnostics. History of biochemistry and development of biochemical research in Ukraine. Chemical composition of living organisms, its features compared with objects of inanimate nature. Chemical composition of the human body. Biochemical components of cells (biomolecules), their biochemical functions. Structure of prokaryotic and eukaryotic cells. Autotrophic and heterotrophic organisms. | 2 | Study and analysis of basic and auxiliary literature, videos, video films, webinar, | Oral examination (individual and frontal); written survey; test control. |

| | | | | |
|---|---|---|---|---|
| 2. | ***Topic 2***. Oligomeric enzyme proteins, multienzyme complexes and membrane-associated enzymes. Isoenzymes: features of the structure, localization of synthesis in the human body (on the example of lactate dehydrogenase, creatine phosphokinase isoenzymes); role in the diagnosis of diseases. Methods of extracting enzymes from biological objects, their fractionation and analysis of enzyme activity. Methods of determination of enzyme activity. | 2 | virtual consultation. | |
| 3. | ***Topic 3***. The history of the discovery of vitamins, the role of scientists in the development of vitaminology. Exogenous and endogenous hypo- and avitaminosis. Clinical and biochemical aspects of vitamin deficiency. Vitamin F (complex of polyunsaturated higher fatty acids): structure of complex components, participation in metabolism; sources, daily need, symptoms of deficiency. General characteristics of vitamin-like substances; the role of carnitine, ubiquinone and lipoic acid in the metabolism of substances. Antivitamins; peculiarities of structure and action; use in medicine. | 2 | | |
| 4. | ***Topic 5***. Interrelationship of energy production and consumption processes in living systems. The energy of chemical bonds as the main type of energy used by cells to ensure their vital activity. Mitochondrial ATP synthetase, structure and principles of functioning. Chemiosmotic theory of oxidative phosphorylation. | 2 | Study and analysis of basic and auxiliary literature, videos, video films, webinar, virtual consultation. | Oral examination (individual and frontal); written survey; test control. |
| 5. | ***Topic 6***. Exergonic and endergonic biochemical reactions; the role of ATP and other macroergic phosphates in the coupling of processes that occur with the release and storage of energy. Methods of studying metabolism. | 2 | | |
| 6. | ***Topic 7***. The family of proopiomelanocortin (POMK) is the processing products of POMK (adrenocorticotropin, lipotropins, endorphins). Hormones of the alimentary canal: gastrin, secretin, cholecystokinin. General characteristics of thymus hormones; their structure and role. Structure and role of melatonin, place of synthesis. | 2 | | |
| 7. | ***Topic 8***. Clinical use of analogues and antagonists of gonadal hormones. Eicosanoids. | 3 | | |
| 8. | ***Topic 9***. The role of carbohydrates in the vital activity of the body. The most important representatives of body carbohydrates, their chemical structure, properties, biological significance. Energy value of carbohydrates. A person's daily need for carbohydrates. Blood glucose. Regulation of the level of glucose in the blood. Methods of determining glucose content in blood and urine, their significance. | 2 | | |
| 9. | ***Topic 10***. Comparative characteristics of bioenergetics of aerobic and anaerobic oxidation of glucose. Relationship and reciprocal regulation of glycolysis and gluconeogenesis in the body. Glucose-lactate and glucose-alanine cycles. Metabolism of fructose and | 2 | | |

| | | | | |
|---|---|---|---|---|
| | galactose in the human body. Glycosaminoglycans: structure, role; general ideas about metabolism. Violation of carbohydrate metabolism. | | | |
| 10. | ***Topic 11***. Lipids: biological role, classification, structure and functions of simple lipids, structure and functions of complex lipids (phospholipids and glycolipids). Fat resynthesis in intestinal epithelial cells; its meaning; the role of β-MAG in this process. | 2 | | |
| 11. | ***Topic 12***. Metabolism of phosphoglycerols and sphingolipids. Genetic abnormalities of sphingolipid metabolism - sphingolipidoses. "Lysosomal diseases": Niemann-Pick disease, Tay-Sachs disease, Gaucher disease. Biosynthesis of monounsaturated higher fatty acids in the human body. | 3 | | |
| ***Part 2. Exchange of proteins and nucleic acids. Functional biochemistry.*** | | | Study and analysis of basic and auxiliary literature, videos, video films, webinar, virtual consultation. | Oral examination (individual and frontal); written survey; test control. |
| 12. | ***Topic 1***. The role of proteins in the vital activity of the body. Complete and incomplete proteins. Replaceable, irreplaceable, conditionally or partially replaceable amino acids. Types of acidity of gastric juice, methods of its determination. Clinical and diagnostic value of gastric juice analysis. Risk factors for the formation of ulcers and stomach tumors. Diagnostic value of qualitative determination of lactic acid in gastric juice. | 3 | | |
| 13. | ***Topic 2***. Glycogenic amino acids; physiological significance and regulation of gluconeogenesis processes from amino acids. Ketogenic and glyco-ketogenic amino acids. | 3 | | |
| 14. | ***Topic 3***. Scheme of arginine exchange pathways; nitric oxide as a product of arginine metabolism, its role in the body. Scheme of pathways of exchange of dicarboxylic amino acids. | 3 | | |
| 15. | ***Topic 4***. Нуклеотиди, їх структура та роль в організмі. Перетравлення й всмоктування нуклеопротеїнів. Синтез дезоксирибонуклеотидів. Взаємозв'язок між обміном білків та нуклеїнових кислот. Кінцеві продукти катаболізму простих і складних білків (нуклеопротеїнів). Нітрогеновий баланс, його види. | 5 | | |
| 16. | ***Topic 5***. Modern methods of determining the acid-alkaline state of blood. Blood immunoglobulins, structure, functions. Acute phase proteins, the clinical and diagnostic value of their determination. Inorganic blood components: content, role. Kallikrein-kinin system, its role in the body; use of drugs - kallikrein and inhibitors of kinin formation. | 1 | | |
| 17. | ***Topic 6***. Neurohumoral regulation of water-salt exchange. Phosphate-calcium metabolism, the role of hormones and vitamins in its regulation; mineral and organic phosphates; urinary phosphates. The role of hormones and vitamins in the regulation of mineral metabolism. | 3 | | |

| | | | | |
|---|---|---|---|---|
| | | | | |
| 18. | ***Topic 7***. Kidney functions and metabolic features in them. Biochemical mechanisms of regulation of renal function. General properties and chemical composition of normal urine. The value of the study in the clinic. Organic and inorganic substances of normal urine; their changes depending on age. | 4 | | |
| 19. | ***Topic 8***. Macroergic compounds of nervous tissue. Bioenergetics of muscle tissue. Changes in muscles in muscular dystrophy, hypodynamia, vitamin deficiency E. Features of regulation of connective tissue metabolism. | 4 | | |
| 20. | **Total number of hours** | 50 | | |

## 3. EVALUATION CRITERIA

**Assessment of current educational activity (CEA)**

Evaluation criteria for current educational activities:

The grade "EXCELLENT" is awarded to a student who took an active part in the discussion of the most difficult questions on the topic of the lesson, gave at least 90% correct answers to standardized test tasks, solved situational tasks without errors, completed practical work, drew up a protocol, fully substantiated the obtained results.

A grade of "GOOD" is awarded to a student who participated in the discussion of the most difficult questions on the subject of the lesson, gave at least 75% correct answers to standardized test tasks, made some minor mistakes when solving situational problems, completed practical work and issued a protocol, but not completely substantiated the obtained data.

The grade "SATISFIED" is given to a student who did not participate in the discussion of the most difficult questions on the topic, gave at least 60% correct answers to standardized test tasks, made significant mistakes in answers to written tasks, solved situational tasks with errors, completed practical work and drew up the protocol, but did not fully substantiate the received data.

The grade "UNSATISFACTORY" is given to a student who did not participate in the discussion of the most difficult questions on the topic, gave less than 60% correct answers to standardized test tasks, made gross mistakes in answers to written tasks or did not give answers to them at all, did not complete practical work and did not draw up the protocol, cannot interpret its results.

During the evaluation of mastering of each subject of the discipline (PND) and the final lesson (PL), the student is given a grade according to the traditional 4-point system: "excellent", "good", "satisfactory" and "unsatisfactory".

The final control work by section is carried out in accordance with the specific goals of the sections of the academic discipline. The degree of assimilation of the material for independent study is also checked within the control work.

Assessment of the final lesson: 1) solving basic test tasks that cover the content of the educational material of the final lesson (90.5% of correctly solved tasks); 2) evaluation of the acquisition of practical skills (evaluation criteria – "passed" or "failed"); 3) solution of theoretical questions included in this software (a traditional assessment is given).

Assessment of students' independent work: mastery of topics that are presented only for independent work is checked during the final class and differentiated assessment.

Assessment of individual student tasks: points for individual tasks are awarded to the student once only by commission (committee - head of department, head teacher, teacher of the group) only under the conditions of successful completion and defense. In no case can the total sum of points for PND exceed 120 points.

The final score for PND and PZ is defined as the arithmetic average of traditional grades for each lesson and PZ, rounded to 2 decimal places and recalculated in a multi-point scale according to table 1.

Table 1

**Recalculation of the average grade for the current activity into a multi-point scale**

| 4-point scale | 200-point scale | 4-point scale | 200-point scale |
|---|---|---|---|
| 5 | 120 | 4.45-4,49 | 107 |
| 4.95-4,99 | 119 | 4.41-4,44 | 106 |
| 4.91-4,94 | 118 | 4.37-4,4 | 105 |
| 4.87-4,9 | 117 | 4.33-4,36 | 104 |
| 4.83-4,86 | 116 | 4.29-4,32 | 103 |
| 4.79-4,82 | 115 | 4.25- 4,28 | 102 |
| 4.75-4,78 | 114 | 4.2- 4,24 | 101 |
| 4.7-4,74 | 113 | 4.16- 4,19 | 100 |
| 4.66-4,69 | 112 | 4.12- 4,15 | 99 |
| 4.62-4,65 | 111 | 4.08- 4,11 | 98 |
| 4.58-4,61 | 110 | 4.04- 4,07 | 97 |
| 4.54-4,57 | 109 | 3.99-4,03 | 96 |
| 4.5-4,53 | 108 | 3.95- 3,98 | 95 |

| 4-point scale | 200-point scale | 4-point scale | 200-point scale |
|---|---|---|---|
| 3.91-3,94 | 94 | 3.37-3,4 | 81 |
| 3.87-3,9 | 93 | 3.33- 3,36 | 80 |
| 3.83- 3,86 | 92 | 3.29-3,32 | 79 |
| 3.79- 3,82 | 91 | 3.25-3,28 | 78 |
| 3.74-3,78 | 90 | 3.21-3,24 | 77 |
| 3.7- 3,73 | 89 | 3.18-3,2 | 76 |
| 3.66- 3,69 | 88 | 3.15- 3,17 | 75 |
| 3.62- 3,65 | 87 | 3.13- 3,14 | 74 |
| 3.58-3,61 | 86 | 3.1- 3,12 | 73 |
| 3.54- 3,57 | 85 | 3.07- 3,09 | 72 |
| 3.49- 3,53 | 84 | 3.04-3,06 | 71 |
| 3.45-3,48 | 83 | 3.0-3,03 | 70 |
| 3.41-3,44 | 82 | Less than 3 | Insufficiently |

**Conducting and evaluating differentiated credit**

Differentiated assessment is carried out upon completion of the study of the discipline. Students who have completed all types of work provided for in the curriculum and do not have missed lectures and practical classes are admitted to the differentiated assessment. The form of differential assessment is standardized and includes control of theoretical and practical training.

1. Solving a package of test tasks in the penultimate lesson (the evaluation criterion is 100% of correctly solved tasks, "passed - failed").

2. Evaluation of the acquisition of practical skills (according to the criteria "performed", "did not perform").

3. Evaluation of the assimilation of theoretical knowledge according to table 2

Table 2

**Criteria for evaluating theoretical knowledge**

| Number of questions | «5» | «4» | «3» | Oral answer for question cards including theoretical part of discipline | Each student answer receives from 10 to 16 points, corresponding to:<br>«5» - 16 points;<br>«4» - 13 points;<br>«3» - 10 points. |
|---|---|---|---|---|---|
| 1 | 16 | 13 | 10 | | |
| 2 | 16 | 13 | 10 | | |
| 3 | 16 | 13 | 10 | | |
| 4 | 16 | 13 | 10 | | |
| 5 | 16 | 13 | 10 | | |
| | 80 | 65 | 50 | | |

The grade "EXCELLENT" is awarded to a student who gave thorough and complete answers to all theoretical questions and solved situational problems without errors. During the differentiated assessment, the student demonstrates a comprehensive and deep assimilation of the curriculum material from all sections; fully possesses theoretical knowledge and practical skills; understands the general biological and medical significance of the discipline, its connection with professionally oriented disciplines; mastered basic and additional educational literature, lecture course.

A grade of "GOOD" is awarded to a student who gave full answers to all theoretical questions with minor errors, made some minor mistakes when solving situational problems. During the differentiated assessment, the student demonstrates full mastery of the curriculum material from all sections; has good theoretical knowledge and practical skills; understands the general biological and medical significance of the discipline, its connection with professionally oriented disciplines; mastered the basic educational literature and the lecture course.

The grade "SATISFACTORY" is given to a student who did not fully answer the theoretical questions or made significant mistakes; made significant mistakes in solving situational problems. During the differentiated assessment, the student demonstrates mastery of only the basics of the educational program material; did not master all practical skills; cannot independently explain the connection of biochemistry with other professionally oriented disciplines; did not fully master the educational literature and the lecture course.

The grade "UNSATISFACTORY" is given to a student who made gross mistakes in answering theoretical questions or did not answer them at all; answers to situational problems. During the differentiated assessment, the student demonstrates a lack of systematic knowledge and skills, does not possess practical skills, makes fundamental mistakes in answering theoretical questions and solving situational problems, has not mastered the basic educational literature and the lecture course.

**Discipline assessment**

The grade in the discipline is defined as the arithmetic average of the points for two semesters, which are translated into the 120-point scale of the ECTS with the

addition of points obtained directly on the differentiated assessment. The maximum number of points that a student can earn for studying a discipline is 200 points, including the maximum number of points for current educational activity - 120 points, as well as the maximum number of points based on the results of differentiated assessment - 80 points. The minimum number of points is 120, including the minimum current educational activity - 70 and based on the results of differentiated assessment 50 points.

**Technology of discipline assessment**

The evaluation of the results of the study of the discipline is carried out directly during the differentiated assessment. The grade for the discipline is defined as the sum of the points for PND and the differential assessment and is a minimum of 120 points, a maximum of 200 points. Correspondence of grades on the 200-point scale, the four-point (national) scale and the ECTS scale are shown in Table 3:

| Mark in a 200-point scale | ECTS-based mark | National four-scale-based mark |
|---|---|---|
| 180-200 | A | Excellent |
| 160-179 | B | Good |
| 150-159 | C | Good |
| 130-149 | D | Satisfactory |
| 120-129 | E | Satisfactory |
| Below 120 | F, Fx | Unsatisfactory |

## 3.2. THE LIST OF DIFFERENTIATED SCORING

**Theoretical questions.**

1. General information about the structure and classification of amino acids.
2. Physico-chemical properties of proteins.
3. Normal protein content in blood serum. The diagnostic value of its definition.
4. Modern ideas about the structural organization of protein.

Macroergic compounds and their significance.

5. The concept of chromoproteins. Structure of hemoglobin, forms of hemoglobin. Diagnostic value of determination of hemoglobin content.
6. Lipoproteins. Structural and biological role.
7. Structure of enzymes. Properties of enzymes as biological catalysts.
8. Concept of active center, allosteric centers, substrate center. Their importance in the enzymatic process.
9. Isoenzymes. Their structure and meaning.
10 The concept of the mechanism of action of enzymes.
11. Specificity of enzyme action. Types of specificity.
12. Enzyme effectors.
13. Regulation of enzyme activity in the body.
14. Modern ideas about biological oxidation.
15. Mechanisms of tissue respiration.
16. The structure of mitochondria and the structural organization of the redox chain of electron and proton transport.
17. Complete and shortened chain of tissue respiration. Energetic effect of biological oxidation.
18 General information about substrate phosphorylation.
19. General characteristics of vitamins. Provitamins. Antivitamins.

20. Vitamin B1 – natural sources, daily requirement, biological role.
21. Vitamin B2 - natural sources, daily requirement, biological role, signs of hypovitaminosis.
22. Vitamin PP - natural sources, daily requirement, biological role, signs of hypovitaminosis.
23. Vitamin B12 – natural sources, daily requirement, biological role.
24. Vitamin C – natural sources, daily requirement, biological role.
25. Vitamin A - natural sources, daily requirement, biological role, signs of hypovitaminosis.
26. Vitamin D – natural sources, daily requirement, biological role, signs of hypovitaminosis.
27. Vitamin E – natural sources, daily requirement, biological role, signs of hypovitaminosis.
28 Vitamin K – natural sources, daily requirement, biological role, signs of hypovitaminosis.
29. Hormones, classification, their place in hierarchical levels of regulation. Mechanisms of hormone action.
30. Thyroid hormones. Metabolic changes in hyperthyroidism and hypothyroidism.
31. Regulation of phosphorus-calcium exchange by parathyroid hormone, calcitonin.
32. Insulin, structure and significance in the regulation of metabolism. Diabetes, its causes, types, diagnosis.
32. Glucagon, chemical nature, mechanism of action, significance in the regulation of carbohydrate metabolism.
33. Pituitary hormones, structure, influence on metabolism.
34. Regulatory factors of the hypothalamus, their structure and mechanism of action.
35. Hormones of the cortical layer of the adrenal glands, influence on metabolism.
36. Male and female sex hormones, influence on metabolism.
37. Use of hormonal drugs in medicine.
38. General information about carbohydrates. Monosaccharides, their chemistry, biological significance.
39. Polysaccharides, their structure and biological role.
40. Biochemical processes during digestion and absorption of carbohydrates.
41. General scheme of sources and ways of glucose conversion in the human body.
42. Glycogen exchange and its regulation. Glycogenoses and aglycogenoses.
43. Anaerobic conversion of carbohydrates.
44. Gluconeogenesis, biological significance.
45. Aerobic glycolysis.
46. The value of the pentose phosphate cycle.
47. Cycle of tricarboxylic acids, energy effect, biological significance.
48. The role of the liver in carbohydrate metabolism.
49. Hormonal regulation of carbohydrate metabolism.
50. General information about lipids, their biological significance
51. General information about biochemical processes during digestion of lipids and peculiarities of absorption of lipids, food lipids.
52. Characteristics of the main classes of blood lipoproteins and their role in lipid transport.
53. Mobilization of reserve fats, influence of hormones.
54. Concept of β-oxidation of fatty acids. Energy balance.
55. Concept of biosynthesis of higher fatty acids. The role of biotin in this process.
56. Concept of biosynthesis and breakdown of ketone bodies and their biological role.
57. Regulation and pathology of lipid metabolism.
58. Biological value of food proteins. The norm of proteins in food.
59. Digestion of proteins in the gastrointestinal tract.
60. Decay of proteins in the colon and detoxification of toxic decay products.
61. The concept of types of deamination of amino acids. Characteristics of oxidases.
62. General information about transamination, characteristics of transamination.
63. Ways of formation and neutralization of ammonia in the human body. Glutamine cycle.
64. Insights into the biosynthesis of urea and the role of the liver in this process.

65. General characteristics of the decarboxylation process of amino acids. Formation of biogenic amines.
66. Specific pathways of amino acid metabolism.
67. Pathology of protein metabolism.
68. The role of the liver in regulating the metabolism of carbohydrates, lipids and proteins.
69. Pathology of the exchange of bile pigments.
70. Biosynthesis of DNA.
71. Biosynthesis of RNA. Genetic code.
72. Insights into protein biosynthesis and its regulation.
73. Physical and chemical properties of blood.
74. Buffers of the blood system and their mechanism of action.
75. Blood plasma proteins and their main functions
76. Blood serum enzymes, their origin, causes of hypo- and hyperenzymemia.
77. Functions and exchange of water.
78. Sources of mineral substances in the body and their functions.
79. The role of kidneys, aldosterone, renin-angiotensin system in regulation of water-salt exchange.
80. Exchange and functions of sodium and potassium.
81. Exchange and functions of calcium and phosphorus, regulation.
82. Indicate inorganic and organic components of urine in the norm, their origin and amount in daily urine.
83 Pathological folds of urine, causes of their appearance.
84. Glycosaminoglycans of connective tissue, structure, meaning.
85. biochemical tests in the diagnosis of connective tissue diseases.
86. Features of the amino acid composition of the brain.
87. Peculiarities of brain tissue metabolism.

**Required practical skills**

1. Quantitative determination of lactate dehydrogenase activity in blood serum according to Sevel and Tovarek.
2. Qualitative determination of 17-ketosteroids in urine.
3. Determination of glucose in urine
4. Quantitative determination of glucose in the blood by the glucose oxidase method
5. Qualitative reactions to ketone substances (bodies) in urine
6. Determination of cholesterol concentration in blood serum enzymatically using a set of reagents
7. Determination of aspartate aminotransferase activity in blood serum according to King
8. Quantitative determination of urea in biological fluids
9. Determination of creatinine content in biological fluids
10. Determination of the content of uric acid in biological fluids according to the method of Muller and Seifert
11. Quantitative determination of total protein in blood serum by the biuret method
12. Research of physicochemical properties and chemical composition of normal urine. Determination of pathological components of urine.

### 3.3. Rules for appealing the assessment

The appeal of the assessment received by the student of higher education is carried out in accordance with the "Regulations on the appeal of the results of the final control of students of the KhNMU" approved by the Order of the KhNMU dated September 30, 2020 No. 252.

## 4. DISCIPLINE POLICY.

In order to successfully complete the relevant course, it is necessary to regularly attend practical classes; to have theoretical preparation for practical classes according to the subject; not to be late and not to miss classes; perform all necessary tasks and work

in each lesson; be able to work with a partner or in a group; to address to teachers of a course on various questions on subjects of employment and to receive it when you need it. Students can discuss different tasks, but their performance is strictly individual. It is not allowed to write off, use various software, tips, use a mobile phone, tablet or other electronic gadgets during classes for purposes other than the educational process. Students are not allowed to be late for practical classes.

Students with special needs can meet with the teacher or warn him before the start of classes, at the request of the student it can be done by the head of the group. If you have any questions, please contact the teacher.

Students' participation in research and conferences on this topic is encouraged.

All students of KhNMU are protected by the Regulations on Prevention, Prevention and Settlement of Cases Related to Sexual Harassment and Discrimination at Kharkiv National Medical University, designed to define an effective mechanism for resolving conflict situations related to discrimination and sexual harassment. This Regulation is developed on the basis of the following normative legal acts of Ukraine: the Constitution of Ukraine; Law of Ukraine "On Education"; Law of Ukraine "On Higher Education"; Law of Ukraine "On Principles of Preventing and Combating Discrimination in Ukraine"; Law of Ukraine "On Ensuring Equal Rights and Opportunities for Women and Men"; Convention for the Protection of Human Rights and Fundamental Freedoms; Convention for the Suppression of Discrimination in Education; Convention on the Elimination of All Forms of Discrimination against Women; General Recommendation № 25 to paragraph 1 of Article 4 of the Convention on the Elimination of All Forms of Discrimination against Women; Cultural Rights; UN Committee on Economic, Social and Cultural Rights); Recommendations on education in the spirit of international understanding, cooperation and peace and education in the spirit of respect for human rights and fundamental freedoms (UNESCO); The concept of the State social program to ensure equal rights and opportunities for women and men for the period up to 2021. Kharkiv National Medical University provides education and work that is free from discrimination, sexual harassment, intimidation or exploitation. The University recognizes the importance of confidentiality. All persons responsible for the implementation of this policy (staff of deans' offices, faculties, institutes and the Center for Gender Education, members of the student government and ethics committee, vice-rector for research and teaching) are confidential about those who report or accuse of discrimination. or sexual harassment (except when the law requires disclosure of information and / or when disclosure by the University is necessary to protect the safety of others).

KhNMU creates a space of equal opportunities free from discrimination of any national, racial or ethnic origin, sex, age, disability, religion, sexual orientation, gender, or marital status. All rights, privileges, programs and activities granted to students or staff of the University apply to all without exception, provided they are properly qualified. The anti-discrimination policy and the policy of counteracting sexual harassment of KhNMU are confirmed by the Code of Corporate Ethics and the Charter of KhNMU.

***Behavior in the audience***

It is important for students to follow the rules of appropriate behavior at the university. These rules are general for everyone, they also apply to all professors and teaching staff and employees, and fundamentally do not differ from generally accepted norms. During classes, it is allowed to: leave the audience for a short time if necessary and with the teacher's permission; drink soft drinks; take photos of presentation slides; take an active part in the lesson. It is forbidden: to eat (with the exception of persons whose special medical condition requires otherwise - in this case, medical confirmation is required); smoke, consume alcoholic and low-alcoholic beverages or narcotic drugs; speak obscenely or use words that insult the honor and dignity of colleagues and teaching staff; gaff; to cause damage to the material and technical base of the university (damage inventory, equipment; furniture, walls, floors, litter premises and territories); making noise, shouting or listening to loud music in the classrooms and even in the corridors during classes.

***Occupational Health***

The first lesson of the course will explain the basic principles of labor protection by conducting appropriate training. It is expected that everyone should know where the nearest evacuation exit to the audience, where the fire extinguisher is, how to use it, and so on.

## 5. ACADEMIC INTEGRITY

Applicants must adhere to the principles of academic integrity set forth in the Code of Academic Integrity of Kharkiv National Medical University, which is designed to support the idea of integrity and a dignified relationship between participants in the academic process; promoting the importance of academic integrity; resolved issues related to raising the quality of higher education; promoting the development of a positive reputation; raising the rating of teachers and the competitiveness of university graduates; development of skills of conscientious and correct work with sources of information; compliance with the requirements of scientific ethics and respect for the intellectual property of others; activation of independence and individuality in the creation of their own works, as well as increasing the responsibility for violating the generally accepted rules of citation.

The main tasks of implementing the policy of academic integrity at the University are: prevention and elimination of cases of academic fraud among students and teachers of the University, education of negative attitudes to plagiarism, carrying out constant purposeful work on the development of academic integrity. Teachers, researchers and students who show a desire for academic integrity should be a role model and raise the standard of educational and research activities in general. Violations of the rules of academic integrity should not adversely affect the reputation of the University and reduce the value of educational and scientific degrees obtained at the University.

## 6. References

**Basic**

1. Harper’s Illustrated Biochemistry / V.W. Rodwell, D.A. Bender, K.M. Botham et al. – Mc Graw Hill Education, 2015. – 817 p.
2. Popova L. Biochemistry / Popova L., Polikarpova A. – Kharkiv: KNMU, 2021. – 540 p.

3. Harper's Biochemistry / Murray R.K., Granner D.K., Mayes P.A. et al. – Prentice-Hall Int. Inc., 1998 – 1014 p.

**Extra**

1. Halkerston I.D.K. Biochemistry: 2nd edition / Halkerston I.D.K. – The National medical series for independent study, 1988. – 522 p.
2. Stryer L. Biochemistry / Stryer L. – W.H. Freeman and Company, New York. – 1995. – 1064 p.
3. Molecular Cell Biology / H. Lodish et al. - W.H. Freeman and Company, N. York. – 2016. – 1170 p.

**7. INFORMATION RESOURCES**

1. Link to the discipline page in MOODLE: http://distance.knmu.edu.ua/course/view.php?id=2562
2. Educational portal: http://www.osvita.org.ua.
3. Website of the National Library of Ukraine named after VI Vernadsky:
1. http://nbuv.gov.ua
4. Site of Kharkiv State Scientific Library named after VG Korolenko http://korolenko.kharkov.com.
5. Official site of the Ministry of Education and Science of Ukraine: http://www.education.gov.ua.
6. Website of the department: http: // www.knmu.kharkov.ua/.
7. The site of the library of KhNMU: http: // libr.knmu.edu.ua.
8. Provisions on prevention, prevention and settlement of cases related to sexual harassment and discrimination in KhNMU: http://files.knmu.edu.ua:8181/upload/redakt/doc_uchproc/polog-sex.doc
9. Regulations on Academic Integrity and Ethics of Academic Relations at Kharkiv National Medical University: http://files.knmu.edu.ua:8181/upload/redakt/doc_uchproc/polog_ad_etyka_text.pdf
10. The procedure for conducting classes on in-depth study by students of Kharkiv National Medical University of certain disciplines beyond the scope of the curriculum: http: // files.knmu.edu.ua: 8181/upload/redakt/doc_uchproc/nak-poriad-pogl-vyv-dysc.docx
11. Regulations on the Commission for Academic Integrity, Ethics and Conflict Management of KhNMU: http: // files.knmu.edu.ua: 8181/upload/redakt/doc_uchproc/polog_komis_ad_text.pdf.
12. Regulations on the recognition of the results of non-formal education at Kharkiv National Medical University: http://files.knmu.edu.ua:8181/upload/redakt/doc_uchproc/polog_neform_osv.pdf
13. INCLUSIVE EDUCATION: http://www.knmu.kharkov.ua/index.php?option=com_content&view=article&id=7108%3A2021-03-10-14-08-02&catid=12%3A2011-05-10-07-16-32&Itemid=33&lang=uk
14. ACADEMIC INTEGRITY: http://www.knmu.kharkov.ua/index.php?option=com_content&view=article&id=2520%3A2015-04-30-08-10-46&catid=20%3A2011-05-17-09-30-17&Itemid=40&lang=uk