

**National Pirogov Memorial Medical University, Vinnytsya**

**"APPROVE"**

Higher Educational Institution Vice-Rector for  
Scientific and Academic Work and International Links

Inna ANDRUSHKO

" 30 " August 2024

**"AGREED"**

Head of Medical and Biological chemistry  
Department

Prof. of HEI Andrii MELNYK

" 28 " August 2024

**SYLLABUS  
of academic discipline  
"BIOLOGICAL CHEMISTRY"**

Specialty	226 Pharmacy, industrial pharmacy
Educational level	the second (master`s) level
Educational programme	EPP Pharmacy, industrial pharmacy 2023
Academic year	2024-2025
Department	Medical and biological chemistry
Lecturers	Prof. of HEI Andrii MELNYK Assoc. prof. of HEI Vitaliy NECHIPORUK
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Syllabus compilers	Assoc. prof. of HEI Vitaliy NECHIPORUK

## 1. Status and structure of the discipline

Discipline status	Mandatory
Discipline code in EPP/ discipline place in EPP	EdC 16 /discipline of general training
Course / semester	2nd year (III-IV semesters)
The amount of discipline ( the total number of hours / number of credits ECTS)	180 hours / 6,0 credits ECTS
Number of Thematic modules	4 modules
The structure of the discipline	Lectures – 30 hours Practical classes - 70 hours Independent work - 80 hours
Language of study	English
Form of study	Full - time

## 2. Description of the discipline

**Short annotation of the course, relevance.** The biological chemistry as a basic discipline is focused on the training of highly qualified pharmacists (pharmacists) and is one of the most important in the system of medical and pharmaceutical education. It studies the chemical composition, structural organization and properties of bioorganic compounds - components of cells, tissues and organs of the human body, patterns of metabolism and energy at the molecular level in healthy and diseased organisms, provides a theoretical basis for the study of other medical and biological disciplines.

**Prerequisites.** Biological chemistry as an academic discipline is based on the study by students of medical biology, inorganic, analytical, physico-colloidal and organic chemistry, physiology, microbiology and is integrated with these disciplines.

**The purpose of the course and its significance for professional activities.** Biological biochemistry as a discipline aims to train pharmacists who have a significant amount of theoretical and practical knowledge about the biochemical basis of the body functioning and the nature of metabolic processes occurring in the human body in normal and pathological conditions..

**Postrequisites.** The subject lays the foundations for students to study pharmaceutical chemistry, pharmacology, laboratory diagnostics, biotechnology, general and molecular pharmacology, which involves the integration of teaching with these disciplines and the application of knowledge in further education and professional activities.

It lays the foundations for clinical diagnosis of the most common diseases, monitoring the course of the disease, monitoring the effectiveness of drugs and measures aimed at preventing the occurrence and development of pathological processes.

Further improvement of skills to use theoretical and practical knowledge of pathobiochemistry at a higher scientific and methodological level is carried out in a separate training course "Clinical Biochemistry", which is taught in the 3rd year of study to students of the Faculty of Pharmacy

## 3. Learning outcomes.

Know the structure of bioorganic compounds and the functions they perform in the human body; the reactivity of the main classes of biomolecules, which provides their functional properties and metabolic transformations in the body; general biochemical mechanisms of pathological processes in the human body.

To apply the received theoretical knowledge about features of diagnostics of a physiological condition of an organism and development of pathological processes on the basis of laboratory researches; connection of features of structure and transformations in an organism of bioorganic compounds as bases of their pharmacological action as medicines; basic mechanisms of biochemical action and principles of directed application of different classes of pharmacological

agents in professional activity.

Apply practical skills of analysis of norms and changes in biochemical and enzymatic parameters used to diagnose the most common human diseases; the importance of biochemical processes of metabolism and its regulation in ensuring the functioning of organs, systems and the whole human body.

Interpret the structure and transformations of bioorganic compounds in the body as the basis of their pharmacological action as drugs; interpret the biochemical mechanisms of pathological processes in the human body and the principles of their correction.

Have the skills of laboratory research methods and their use to monitor the effectiveness and safety of drugs: the choice of biological objects of analysis, determination of xenobiotics and their metabolites in biological media, evaluation of research results taking into account their distribution in the body.

Explain the main mechanisms of biochemical action and the principles of targeted use of different classes of pharmacological agents in order to optimally prescribe drug treatment.

#### 4. Content and logistic of the discipline

Module 1. (Enzymes. General patterns of metabolism)	III semester 32 hours / 1,1 credits	Lectures № 1-2 Practical classes №№ 1-7 Topics for self- study №№ 1-6
Module 2. (Carbohydrate and lipid metabolism, their regulation)	III semester 42 hours / 1,4 credits	Lectures № 3-6 Practical classes №№ 8-16 Topics for self- study №№ 1-7
Module 3. (Metabolism of simple proteins and amino acids. Molecular biology)	IV semester 50 hours / 1,6 credits	Lectures № 7-10 Practical classes №№ 17-24 Topics for self- study №№ 1-11
Module 4. (Functional biochemistry)	IV semester 56 hours / 1,9 credits	Lectures № 11-15 Practical classes №№ 25-35 Topics for self- study №№ 1-11

The course includes 35 topics, which are divided into 13 thematic modules.

#### **Module 1.** General patterns of metabolism.

*Thematic module 1.* Introduction to biochemistry.  $\alpha$ -Amino acids, peptides and proteins.

Topic 1. Introduction to biochemistry. Biomolecules and cellular structures.

*Thematic module 2.* Enzymes and coenzymes. Metabolism regulation.

Topic 2. Nomenclature, classification and structure of enzymes. Coenzymes.

Topic 3. Properties of enzymes. Kinetics and energy of enzymatic reactions.

Topic 4. Enzymes activities regulation. Activators and inhibitors of enzymes. Isoenzymes. Multienzyme complexes. Medical enzymology.

*Thematic module 3.* General patterns of metabolism.

Topic 5. Common metabolic pathway. Oxidative decarboxylation of pyruvate. Citric Acid Cycle.

*Thematic module 4.* Molecular basics of bioenergy.

Topic 6. Biological oxidation. Tissue respiration. Oxidative phosphorylation.

## **Module 2.** Carbohydrate and lipid metabolism

*Thematic module 5.* Carbohydrate metabolism and its regulation.

Topic 1. Digestion, absorption and transport of carbohydrates. Anaerobic and aerobic oxidation of glucose.

Topic 2. Glycogen metabolism. Gluconeogenesis.

Topic 3. Pentose phosphate cycle. Fructose and galactose metabolism.

Topic 4. Regulation and pathology of carbohydrate metabolism.

*Thematic module 6.* Lipid metabolism and its regulation.

Topic 5. Digestion, absorption and transport of lipids. Lipid peroxidation. Arachidonic acid cascade.

Topic 6. Lipolysis: catabolism of triglycerides, oxidation of glycerol and fatty acids.

Topic 7. Lipogenesis: biosynthesis of fatty acids, triglycerides and phosphoglycerides.

Topic 8. Metabolism of ketone bodies and cholesterol. Regulation and pathology of lipid metabolism.

## **Module 3.** Metabolism of simple proteins and amino acids. Molecular biology.

*Thematic module 7.* Amino acid metabolism. Enzymopathy of amino acid metabolism.

Topic 1. Digestion, absorption and putrefaction of proteins. Nutritional value of proteins.

Topic 2. Decarboxylation and transamination of amino acids.

Topic 3. Deamination of amino acids. Ammonia neutralization. Urea synthesis.

Topic 4. Specialized ways of acyclic and cyclic amino acids metabolism.

*Thematic module 8.* Basics of molecular biology

Topic 5. Metabolism of nucleotides.

Topic 6. Genetic code. Replication. DNA repair. Mutation. Transcription. Processing. Inhibitors.

*Thematic module 9.* Basics of molecular genetics

Topic 7. Translation, its inhibitors. Posttranslational modification of proteins. Regulation of gene expression. Polymerase chain reaction. Genetic engineering.

## **Module 4.** Functional biochemistry

*Thematic module 10.* Molecular mechanisms of hormones action on target cells.

Topic 1. Chemical nature and mechanisms of action of hormones and hormone-like substances. Regulation of metabolism by hormones of central and peripheral endocrine glands.

Topic 2. Regulation of metabolism by hormones of glands of mixed secretion. Endocrine control of Ca and P homeostasis.

*Thematic module 11.* Biochemistry of human nutrition. Vitamins as food components.

Topic 3. Vitaminology. Vitamine-like compounds. Vitamins C and P.

Topic 4. Water-soluble vitamins of B group.

Topic 5. Lipid soluble vitamins.

*Thematic module 12.* Blood biochemistry.

Topic 6. Blood biochemistry. Chemical composition and physicochemical constants. Proteins and enzymes of blood.

Topic 7. Biochemistry of erythrocytes and hemoglobin.

*Thematic module 13.* Functional biochemistry of organs and tissues.

Topic 8. Biochemistry of liver. Pigmentary metabolism. Jaundices.

Topic 9. Detoxification function of liver. Metabolism of xenobiotics.

Topic 10. Water-mineral metabolism. Biochemistry of kidneys and urine.

The topics of the lecture course reveal the problematic issues of the relevant sections of the discipline. Practical classes involve detailed consideration by students of individual theoretical provisions of the academic discipline with the teacher and the formation of skills and abilities in their practical application through individual performance of formulated tasks and solving situational problems.

The student's independent work provides preparation for practical classes and intermediate

tests, study of topics for independent extracurricular work, writing essays, preparation of presentations, tables. The control of mastering the topics of independent extracurricular work is carried out at the intermediate control classes and the final control of the discipline.

Individual work includes the study of scientific literature, preparation of reviews on the topics provided for presentation at the meetings of the student scientific circle, the implementation of scientific and practical researches, participation in specialized competitions, scientific and practical conferences and organization of students' research works.

Thematic plans of lectures, calendar plans of practical classes, thematic plan of independent extracurricular work, volume and directions of individual work are published on the website of the department.

The route for obtaining materials: department of medical and biological chemistry / for students / Full-time education / (medicine) / 2course / Educational materials / or through the link <https://www.vnmdu.edu.ua/> department of medical and biological chemistry. Access to the materials is carried out through the student's corporate account [s000XXX@vnmdu.edu.ua](mailto:s000XXX@vnmdu.edu.ua).

### 5. Forms and methods of monitoring academic performance

Current control in practical studies	Methods: oral or written survey, testing, electronic survey, solving situational problems, conducting laboratory studies, interpreting them and evaluating their results (drawing up a protocol in a workbook)
Control of mastering the thematic section of the discipline at intermediate control lessons	Methods: oral or written survey, electronic testing, situational problem solving, control of practical skills
Final semester control (credit) at the end of the II semester	According to the Regulation of the Academic process in National Pirogov Memorial Medical University, Vinnytsya (link <a href="https://www.vnmdu.edu.ua/General-information">https://www.vnmdu.edu.ua/General information</a> ).
Final control of the discipline - exam	Methods: pre-examination testing, oral questioning (according to the Regulation of the Academic process in National Pirogov Memorial Medical University, Vinnytsya (link <a href="https://www.vnmdu.edu.ua/General-information">https://www.vnmdu.edu.ua/General information</a> )).
Learning success diagnostic tools	Theoretical questions, tests, clinically-oriented situational tasks, practical tasks, practical skills, demonstration.

### 6. Assessment criteria

Knowledge assessment is carried out in accordance with the Regulations of the Academic process in National Pirogov Memorial Medical University, Vinnytsya (link <https://www.vnmdu.edu.ua/en/general-regulations> )

Continuous assessment	On a four point system of traditional assessments: 5 «excellent», 4 «good», 3 «satisfactory», 2 «unsatisfactory»
Midpoint separation assessment	On a four-point system of traditional assessments
Control of practical skills	According to the four-point system of traditional assessments
Pass-fail exam	On a 200-point scale (the arithmetic average grade for the semester is converted into points) Credited: 120 to 200 points Not credited: less than 120 points (See Grading Scale)

Final control of the discipline	Sum of points for pre-examination testing (12-20 points) and oral questioning (38-60 points) (for disciplines included in Step 1,2) Exam grade: 71-80 points - "excellent" 61-70 points - "good" 50-60 points - "satisfactory" Less than 50 points - "unsatisfactory" / did not pass
Discipline assessments:	Current academic assessment - from 72 to 120 points (conversion of the average traditional assessment of practical class on a 120-point scale): 60% of the grade for the discipline Final control - from 50 to 80 points: 40% of the grade for the discipline Individual work - from 1 to 12 points From 122 to 200 points in total.

### Discipline Score Scale: National and ECTS

The sum of grades for all types of educational activities	Score ECTS	Score on a national scale	
		For exam, course project (work), practice	for credit test
180-200	<b>A</b>	excellent	credited
170-179,9	<b>B</b>	good	
160-169,9	<b>C</b>		
141-159,9	<b>D</b>	satisfactory	
122-140,99	<b>E</b>	satisfactory	
0-121,99	<b>FX</b>	unsatisfactory with the possibility of reassembly	is not credited with the possibility of reassembling
0-121,99	<b>F</b>	unsatisfactory with a mandatory reexamination of discipline	is not credited with mandatory reexamination of discipline

### 7. Policy of discipline/course

The student has the right to receive high-quality educational services, access to modern scientific and educational information, qualified advisory assistance during the study of the discipline and mastery of practical skills. The policy of the department during the provision of educational services is student-centered, based on the regulatory documents of the Ministry of Education and the Ministry of Health of Ukraine, the university charter and the procedure for providing educational services, regulated by the basic provisions of the organization of the educational process at National Pirogov Memorial Medical University, Vinnytsya and the principles of academic integrity.

#### **Adherence to the rules of National Pirogov Memorial Medical University, safety techniques in practical classes and rules of behavior during the signal «Air alarm» and other warning signals.**

Observance of the rules of the VNMU regulations, safety precautions at practical classes. Instruction on biosafety, safety of handling chemical reagents and burners is conducted at the first practical lesson by the teacher. The instructed students are registered in the Safety Instruction Journal. A student who has not been instructed is not allowed to perform practical work.

The teacher conducting the class in the event of an alarm (air alarm signal) must stop the class and go to the shelter together with the group. All personnel (including students and teachers) must remain

in shelter until the air warning signal is cancelled. The teacher must inform the students about further actions after canceling the signal: to continue classes in the classroom or to study the material independently (in this case, the testing will take place in the next scheduled class).

**Requirements for preparation for practical classes.** The student must come to the practical session on time, theoretically prepared according to the topic. Tardiness is not allowed (according to the Rules of Internal Procedure for persons studying at National Pirogov Memorial Medical University, Vinnytsya). The student must follow the rules of dress code and look appropriate for the situation. In communication with teachers, employees, comrades and other persons studying and working at National Pirogov Memorial Medical University, be polite, friendly, friendly. While working in the laboratory, students must follow the safety rules (published on the website of the department <https://www.vnmu.edu.ua/> department of medical and biological chemistry).

**Academic integrity.** While studying the discipline, the student must be guided by the Code of Academic Integrity of National Pirogov Memorial Medical University, Vinnytsya (<https://www.vnmu.edu.ua/general-information/Main-documents/Code-of-academic-integrity>). If the norms of academic integrity are violated during the current and final examinations, the student receives a grade of "2" and must work it out to his teacher in the prescribed manner within two weeks after receiving an unsatisfactory grade.

**Missed classes.** Missed classes are made up in accordance with the procedure established in the Regulations on the Organization of the Educational Process at National Pirogov Memorial Medical University, Vinnytsya (link <https://www.vnmu.edu.ua/General-information/Main-documents>) at the time determined by the practice schedule (published on the website of the department <https://www.vnmu.edu.ua/> department of medical and biological chemistry) the next teacher. To make up for a missed class, a student must provide a completed workbook protocol on the relevant topic, pass a test, and answer questions on the topic of the class in writing or orally.

**The procedure for admission to the discipline final control** is given in the Regulations of the Academic process in National Pirogov Memorial Medical University, Vinnytsya (link <https://www.vnmu.edu.ua/en/general-regulations> ). To the final control allowed students who do not have missed practical classes and received an average traditional grade of at least "3".

**Additional individual points.** Individual points in the discipline (from 6 to 12) a student can receive for individual work, the scope of which is published on the department's website in the teaching and methodical materials of the discipline, the number of points is determined by the results IRS according to the Regulation on the organization of the educational process at National Pirogov Memorial Medical University, Vinnytsya (link <https://www.vnmu.edu.ua/General-information/Basic-documents>).

**Conflict resolution.** In the event of misunderstandings and claims against the teacher due to the quality of educational services, assessment of knowledge and other conflict situations, the student must first inform the teacher about his claims. If the conflict issue has not been resolved, the student has the right to appeal to the head of the department in accordance with the Regulation on consideration of appeals by applicants for higher education at National Pirogov Memorial Medical University, Vinnytsya (<https://www.vnmu.edu.ua/General-information/Main-documents>).

**Politics in terms of remote learning.** The distance learning procedure is regulated by the Regulation on the introduction of elements of distance learning at National Pirogov Memorial Medical University, Vinnytsya (<https://www.vnmu.edu.ua/General-information/Main-documents>). The main training platforms for conducting training sessions are Microsoft Team, Google Meets. The procedure for conducting practical classes, exercises and consultations during distance learning is published on the website of the department (<https://www.vnmu.edu.ua/> department of medical and biological chemistry / to the Student).

Feedback with the teacher is carried out through messengers (Viber, Telegram, Whats App) or e-mail (at the choice of the teacher) during working hours.

#### 1. Educational resources

Educational and methodological support of the discipline is published on the website of the department (<https://www.vnmu.edu.ua/> department of medical and biological chemistry to the Student). Consultations are held twice a week according to the consultation schedule.

2. **The schedule and distribution of groups** by teachers is published on the website of the department (<https://www.vnmu.edu.ua/> department of medical and biological chemistry / To the student).

3. **Questions for the final control** of the discipline are published on the website of the department (<https://www.vnmu.edu.ua/> department of medical and biological chemistry to the Student).

The syllabus of the discipline "Biological chemistry" was discussed and approved at the meeting of the department of medical and biological chemistry (record № 1, dated "28" August 2024)

Responsible for the academic  
discipline

  
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(signature)

Assoc. prof. of HEI Vitaliy NECHIPORUK

Acting head of the department

  
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(signature)

Prof. of HEI Andrii MELNYK