National Pirogov Memorial Medical University, Vinnytsya

«APPROVE»
Vice -Rector of from scientific, pedagogical and educational work
_____ Inna ANDRUSHKO
"29" August 2025

"AGREED "
Head of the Biochemistry Department of n. a. Professor O.O. Pentiuk
_____ Prof. of HEI Nataliia ZAICHKO
"27" August 2025

SYLLABUS
of academic discipline
"BIOLOGICAL CHEMISTRY"

Specialty	222 Medicine
Educational level	the second (master`s) level
Educational programme	EPP Medicine, 2023
Academic year	2025-2026
Department	Biochemistry Department n. a. Professor O.O. Pentiuk
Lecturers	Associated professor, PhD, MD O.I. Shtatko Associated professor, PhD, MD D.O. Filchukov
Contact information	biochem@vnmu.edu.ua Pirogov street 56, (0432) 661224
Syllabus compilers	Professor, MD, PhD, DSc N. V. Zaichko Associated professor, PhD, MD O.I. Shtatko

1. Status and structure of the discipline

Discipline status	Compulsory
Discipline code in EPP/ discipline place in EPP	9 / the discipline of natural and scientific (fundamental) training
Course / semester	2nd year (III-IV semesters)
The amount of discipline (the total number of hours / number of credits ECTS)	195 hours / 6,5 credits ECTS
Number of content modules	4 modules
The structure of the discipline	Lectures – 30 hours Practical classes - 102 hours Independent work - 63 hours
Language of study	English
Form of study	Full-time (or remote according to the order)

2. Description of the discipline

Short annotation of the course, relevance. The main focus is to gain knowledge in biological chemistry. Its study is necessary for the successful mastering of a number of clinical disciplines. The subject allows to gain knowledge about the chemical composition of living organisms, 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, the formation of practical skills: biochemical research to identify normal and pathological components in biological fluids (blood, saliva, urine); interpret the results of biochemical studies for the diagnosis of the most common human diseases, congenital and acquired disorders of metabolic processes (enzymopathies, dysvitaminosis, dyslipidemia, etc.); to analyze biochemical processes and their regulation at different stages of metabolism and energy, and to understand their importance in ensuring the functioning of organs and systems of the human body.

Prerequisites. The study of the discipline is based on students' knowledge of basic natural sciences: medical biology, biophysics, medical chemistry (bioinorganic, physical and colloid chemistry), morphological disciplines (anatomy, histology) and integrates with these disciplines. Assimilation of the course occurs simultaneously with the study of normal physiology and intersects at the level of functional biochemistry.

The purpose of the course and its significance for professional activities. The discipline aims to train specialists - physicians who have a significant amount of theoretical and practical knowledge about the chemical composition of living organisms, 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. This will allow you to master the knowledge and skills to conduct biochemical studies to identify normal and pathological components in biological fluids (blood, saliva, urine); interpret the results of biochemical studies for the diagnosis of the most common human diseases, congenital and acquired disorders of metabolic processes (enzymopathies, dysvitaminosis, dyslipidemia, etc.); to analyze biochemical processes and their regulation at different stages of metabolism and energy, and to understand their importance in ensuring the functioning of organs and systems of the human body.

Postrequisites. The subject lays the foundations 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 with these disciplines and the application of knowledge in further education and professional activities (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).

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.

Conduct clinical, categorical diagnosis by assessing the peculiarities of the body's metabolism and the development of pathological processes based on laboratory tests, interpretation of laboratory diagnostic methods, 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.

Analyze the functioning of enzymatic processes occurring in membranes and organelles to integrate metabolism in individual cells with the definition of a complete functional diagnosis.

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. (Generalpatterns of metabolism)	III semester 37 hours / 1,2 credits	Lectures № 1-2 Practical classes №№ 1-9 Topics for self- study №№ 1-5
Module 2. (Carbohydrate and lipid metabolism)	III semester 41 hours / 1,4 credits	Lectures № 3-5 Practical classes №№ 11-20 Topics for self- study №№ 1-9
Module 3. (Metabolism of simple proteins and amino acids. Molecular biology)	IV semester 42 hours / 1,4 credits	Lectures № 6-8 Practical classes №№ 22-32 Topics for self- study №№ 1-6
Module 4. (Functional biochemistry)	IV semester 75 hours / 2,3 credits	Lectures № 9-15 Practical classes №№ 34-51 Topics for self- study №№ 1-10

The course includes 51 topics, which are divided into 4 thematic modules.

Module 1. General patterns of metabolism.
Thematic module 1. Introduction to biochemistry. Biomolecules and cellular structures.
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.
Topic 5. Isoenzymes. Multienzyme complexes. Medical enzymology.
Topic 6. Chemical nature, classifications of coenzymes. Coenzymes of the I group.
Topic 7. Coenzymes of the II group.
Thematic module 3. General patterns of metabolism.
Topic 8. Common metabolic pathway. Oxidative decarboxylation of pyruvate. Citric Acid Cycle.
Thematic module 4. Molecular basics of bioenergy.
Topic 9. Biological oxidation. Tissue respiration.
Topic 10. 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.
Topic 9. Metabolism of sphingolipids. 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.
Topic 4. Specialized ways of acyclic amino acid metabolism.
Topic 5. Specialized ways of metabolism of cyclic amino acids.
Thematic module 8. Basics of molecular biology
Topic 6. The solution of tests for the license exam.
Topic 7. Metabolism of nucleotides.
Topic 8. Genetic code. Replication. DNA reparation. Mutation.
Topic 9. Transcription. Processing.
Topic 10. Translation. Inhibitors of matrix processes.
Thematic module 9. Basics of molecular genetics
Topic 11. Regulation of genes expression. PCR. 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.
Thematic module 11. Biochemistry of metabolism hormonal regulation.
Topic 2. Hormones of central endocrine glands.
Topic 3. Hormones of peripheral endocrine glands.
Topic 4. Hormones of endoexocrine glands.

Topic 5. Endocrine control of Ca and P homeostasis.
Thematic module 12. Biochemistry of human nutrition. Vitamins as food components.
Topic 6. Vitaminolgy. Vitamine-like compounds. Vitamins C and P.
Topic 7. Water-soluble vitamins of B group.
Topic 8. Lipid soluble vitamins.
Thematic module 13. Blood biochemistry.
Topic 9. Blood biochemistry. Chemical composition and physicochemical constants.
Topic 10. Proteins and enzymes of blood.
Topic 11. Biochemistry of erythrocytes and hemoglobin.
Thematic module 14. Functional biochemistry of organs and tissues.
Topic 12. Biochemistry of liver. Pigmentary metabolism. Jaundices.
Topic 13. Detoxificational function of liver. Metabolism of xenobiotics.
Topic 14. Biochemistry of kidneys and urine.
Topic 15. Water-mineral metabolism.
Topic 16. Biochemistry of nervous tissue.
Topic 17. Biochemistry of muscular tissue.
Topic 18. Biochemistry of connective tissue.

The topics of the lecture course reveal the problematic issues of the relevant sections of the discipline. Practical classes provide a theoretical justification of the main issues of the topic and the acquisition of the following practical skills:

1) to analyze the compliance of the structure of bioorganic compounds with the biological functions they perform in the human body;
2) interpret the peculiarities of the body's metabolism and the development of pathological processes on the basis of laboratory tests;
3) analyze the contribution of carbohydrates, lipids, amino acids in ensuring metabolic transformations in different functional states in the body;
4) to interpret the features of the structure and transformations in the body of bioorganic compounds as the basis of their pharmacological action as drugs;
5) interpret the biochemical mechanisms of pathological processes in the human body and the principles of their correction;.
6) explain the basic mechanisms of biochemical action and the principles of targeted use of different classes of pharmacological agents;
7) explain the biochemical and molecular basis of physiological functions of cells, organs and systems of the human body;
8) analyze the functioning of enzymatic processes occurring in membranes and organelles to integrate metabolism in individual cells;
9) classify the results of biochemical studies and changes in biochemical and enzymatic parameters used to diagnose the most common human diseases;
10) to interpret the importance of biochemical processes of metabolism and its regulation in ensuring the functioning of organs, systems and the whole human body.

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 biological and general chemistry / for students / Full-time education / (medicine) / 1-2course / Educational materials / or through the link https://www.vnmu.edu.ua/ department biological and general chemistry. Access to the materials is carried out through the student's corporate account s000XXX@vnmu.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 theend of the II semester	According to the Regulation of the Academic process in National Pirogov Memorial Medical University, Vinnytsya (link https://www.vnmu.edu.ua/General information).
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 https://www.vnmu.edu.ua/General information).
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.vnmu.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	On a 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: 122 to 200 points Not credited: less than 122 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) 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	**A**	excellent	credited
170-179,9	**B**	good	
160-169,9	**C**		
141-159,9	**D**	satisfactory	
122-140,99	**E**	satisfactory	-
0-121,99	**FX**	unsatisfactory with the possibility of reassembly	is not credited with the possibility of reassembling
	F	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 contemporary scientific and educational information, qualified advisory assistance during the study of discipline and mastering practical skills. The policy of the department during the providing of educational services is a student-centered, based on normative documents of the Ministry of Education and the Ministry of Health of Ukraine, the Statute of the University and the Procedure for the Providing of Educational Services regulated by the main principles of the organization of the educational process in National Pirogov Memorial Medical University, Vinnytsya and the principles of academic integrity (link https://www.vnmu.edu.ua/en/general-regulations).

Adherence to the rules of VNMU, safety techniques in practical classes.

Requirements for preparation for practical classes. Student should be present at the practical lesson on time, theoretically prepared according to the topic. Delay is not allowed (according to the Rules of Procedure for persons studying at VNMU). The student must follow the rules of clothing culture and look according to the situation. In communication with teachers, staff,

comrades and other persons studying at VNMU to observe politeness, friendliness, friendliness. Students must observe peace, tranquility, noble behavior in the department. While working in the chemical laboratory, students follow safety rules (published on the website of the department https://www.vnmu.edu.ua/ Department of Biological and General Chemistry).

Usage of mobile phones and other electronic devices. Students should turn off their mobile phones during classes and other activities provided for in the work plans (according to the Rules of Procedure for students at VNMU). It is allowed to use the specified devices with the permission of the teacher, if it is related to the learning process.

Academic integrity. When studying the discipline, the student must be guided by the Code of Academic Integrity and Corporate Ethics of National Pirogov Memorial Medical University, Vinnytsya (link: https://www.vnmu.edu.ua/en/general-regulations)/ Code of Academic Integrity). In case of violation of the norms of academic integrity during the current and final controls 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 assessment.

Missed classes. Missed classes are working out in the manner prescribed by Regulations of the Academic process in National Pirogov Memorial Medical University, Vinnytsya (link https://www.vnmu.edu.ua/en/general-regulations) at the time of work out schedule (published on the website of the department https://www.vnmu.edu.ua/ department of biological and general chemistry) to the teacher on duty. To work out missed lesson student should provide a completed workbook protocol on the relevant topic, take a test and answer questions in writing or orally to the topic of the lesson. The practice of missed lectures is carried out after providing a synopsis of lecture material, or writing an abstract, or preparing your own presentation on the topic of missed lectures.

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 lectures and received an average traditional grade of at least "3".

Additional points. Individual points in the discipline (from 1 to 12) that student can receive for individual work, the amount of which is published on the website of the department in the educational methodical materials of the discipline, the number of points is determined by the results of IRS according to Regulation of the Academic process in National Pirogov Memorial Medical University, Vinnytsya (link https://www.vnmu.edu.ua/en/general-regulations).

Conflict resolution. In case of misunderstandings and complaints to the teacher because of the quality of educational services, knowledge assessment and other conflict situations, student should submit his / her claims to the teacher. If the issue is not resolved, the student has the right to apply to the head of the department according to Complaints Consideration Procedure in VNMU named after M.I. Pirogov (link https://www.vnmu.edu.ua/en/general-regulations)

Politics in terms of remote learning. Distance learning regulated by the Regulations of the elements of remote learning in National Pirogov Memorial Medical University, Vinnytsya (https://www.vnmu.edu.ua/ General information). The main training platforms for studying are Microsoft Team and Google Meets. Practical classes and lectures, exercises and consultations during distance learning is published on the website of the department (https://www.vnmu.edu.ua/ en/ Department of Biological and General Chemistry / to Students or https://www.vnmu.edu.ua/en/Department of Microbiology / News).

Feedback from teachers is via messengers (Viber, Telegram, WhatsApp) or e-mail (at the teacher's choice) 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/ en/ department of biological and general chemistry / for students). Consultations are held twice a week according to the schedule.
2. **The timetable and distribution of groups** with assigned teachers are published on the web page of the department ((https://www.vnmu.edu.ua /en/ department of biological and general chemistry / for students).
3. Questions to the intermediate and final semester control (credit) of the discipline are published on the web page of the department (https://www.vnmu.edu.ua / en/ department of biological and general chemistry / for students).

The syllabus of the discipline "Biological chemistry" was discussed and approved at the meeting of the Biochemistry Department n. a. Professor O.O. Pentiuk (record № 1, dated "27" August 2025)

Responsible for the academic discipline _____ Ass. prof. of HEI Denis Filchukov
(signature)

Head of the department _____ Prof. of HEI Nataliia ZAICHKO
(signature)