

SYLLABUS OF THE EDUCATIONAL COMPONENT**BIOORGANIC CHEMISTRY**

(title of the educational component)

Speciality: 222 «Medicine» Volume: 3 credits ECTS (90 hours)
Educational and professional program: Medicine Training sessions: lectures, Practical
Component code in the educational program: MC 6 **Classes**
Higher education level: second (master's degree) Final control: Graded credit
Form of education: full-time Prerequisites: Fundamentals of organic
Year of study: 1 **chemistry acquired in secondary education**
Semester(s): II (spring)
Type of educational component: mandatory
Academic year: **2024-2025**

Department/Unit: Department of Medical and Bioorganic Chemistry, 4 Nauky Ave., Building A, 6th Floor

Head of the educational component: Prof. Syrova Ganna, ho.syrova@knu.edu.ua

Page of the educational component in the Distance Learning System of KhNMU (Moodle):
<https://distance.knu.edu.ua/course/view.php?id=504>

DESCRIPTION OF THE EDUCATIONAL COMPONENT

“Bioorganic Chemistry” studies the structures and functions of the main classes of biomolecules, the metabolism of substances and energy, and the molecular basis of the functioning of living organisms in normal and pathological conditions.

PURPOSE OF THE COURSE: Students systematically study the chemical composition, structural organization, and properties of bioorganic compounds — the constituent components of human cells, tissues, and organs. They explore the regularities of metabolism and energy exchange at the molecular level in healthy and diseased organisms and, on this basis, develop clinical-biochemical and scientific thinking necessary for the successful mastering of professionally oriented medical and theoretical disciplines (such as pathological physiology, pharmacology, and clinical courses).

LEARNING OUTCOMES: Upon successful completion of the course, students will be able to:

- Demonstrate the ability to determine the necessary list of laboratory and instrumental studies and to evaluate their results.
- Identify appropriate dietary patterns for the treatment and prevention of diseases.
- Assess the impact of environmental, socio-economic, and biological determinants on the health of individuals, families, and populations.
- Communicate their knowledge, conclusions, and arguments on health-related issues clearly and unambiguously to both professional and non-professional audiences, including students.
- Adhere to professional and academic integrity, and take responsibility for the reliability of obtained scientific results.
- Know the reactivity of carbohydrates, lipids, amino acids, and heterocycles that underlie their functional properties and metabolic transformations in the organism.
- Analyze the correspondence between the structure of bioorganic compounds and their physiological functions in the human body.
- Interpret the structural features and metabolic transformations of bioorganic compounds as the basis of their pharmacological activity as medicinal agents.

CONTENT OF THE EDUCATIONAL COMPONENT

List of lecture topics (10 hours):

1. Bioorganic chemistry, Classification, structure and reactivity of bioorganic compounds.
2. Classification, structure and chemical properties of carbohydrates.
3. Structure and chemical properties of carboxylic acids. Lipids.
4. α -amino acids, peptides, and proteins.
5. Heterocyclic compounds. Structure, properties and biological role of nucleic acids.

List of topics of laboratory-practical classes (30 hours):

1. Classification, nomenclature and isomerism of bioorganic compounds. Nature of chemical bond. Spatial structure of organic molecules. Mutual influence of atoms in bioorganic compounds.
2. Classification of chemical reactions. Reactivity of alkanes, alkenes, arenes, alcohols and phenols.
3. Structure and properties of aldehydes and ketones. Structure, properties and biological role of carboxylic acids and amines.
4. Structure, properties and biological role of functional derivatives of carboxylic acids (hydroxyacids, keto acids, and phenolic acids). Amino acid composition of proteins and peptides. Structural organisation of proteins. Denaturation.
5. Carbohydrates. Structure and chemical properties of monosaccharides. Structure and functions of di- and polysaccharides.
6. Higher fatty acids. Lipids, Phospholipids.
7. Classification, structure and role of biologically important heterocycles. Structure and biochemical functions of nucleosides, nucleotides, and nucleic acids. Structure and biochemical functions of DNA. Differences in structure, functions of RNA and DNA.
8. Graded test.

List of topics of independent work of the student (50 hours)

1. Types of hybridization of the carbon atom. Newman's conformations. Inductive and mesomeric effect. Conjugate and aromatic systems. Application the computer program Quantitative Structure-Activity Relationship (QSAR) to predict the quantitative relationship between the structure of a bioorganic compound and its properties. Application of computer program GUSAR (General Unrestricted Structure-Activity Relationships) to estimate toxicity of bioorganic compounds.
2. Types of chemical reactions in organic chemistry. Reactivity of alkanes, alkenes, arenes.
3. Polymerization and polycondensation reactions of aldehydes and carboxylic acids. To be able to interpret the results of laboratory tests of biological fluids for the content of aldehyde, glucose, ketone bodies.
4. Interconversion of ketone and hydroxy acids (reduction reactions, oxidation, decarboxylation, aldol addition. Keto-enol tautomerism Optical activity of heterocyclic compounds. Be able to interpret the results of laboratory studies of biological fluids on the content of amino acids, peptides and proteins.
5. Stereoisomerism and tautomerism of monosaccharides. D, L-stereochemical series. To be able to distinguish enantiomers and diastereomers among the given compounds. Anomers, epimers. silver mirror test. Glycosides, their structure and biological role of anthraglycosides and cardio glycosides. Neuraminic acid. Reducing and non-reducing disaccharides. Heteropolysaccharides: hyaluronic acid, chondroitin sulfate, heparin.
6. Simple and complex saponifiable lipids. The reactivity of lipids that provides their functional properties and metabolic transformations. Triglycerides. Cholesterol: LDL and HDL. Atherosclerosis. Low molecular weight bioregulators - terpenes, carotenoids and steroids
7. Five-membered and six-membered heterocycles with one and two heteroatoms. Lactime-lactam andazole tautomerism. Predicting the toxicity of heterocyclic compounds using computer program GUSAR (General Unrestricted Structure-Activity Relationships). Alkaloids: structural peculiarities and biological role. Structure and biochemical functions of nucleosides, nucleotides, and nucleic acids. The structure of the coronavirus. Medical and biological aspect.

8. Work with lecture note, with electronic learning management system MOODLE. Preparation for Graded Test.

The IWS is aimed at deepening and consolidating the theoretical knowledge gained during classroom training and contributing to the formation of professional competencies. The results of the IWS are subject to control and are included in the final control of knowledge.

Consultations: *offline/online, according to the schedule of the department or by pre-registration, indicating the method of registration.*

Teaching methods: Storytelling and explanation, discussion, lecture, illustration, demonstration, presentation, video clips, educational films, discussion sessions, round table, business, role-playing and simulation games, process and situation modeling, case study method, project-based learning, debates, brainstorming, webinar, peer learning (sparring partnership), and virtual consultation.

EVALUATION

Current Learning Activities (CLA). The assessment of the success of students of education is carried out in accordance with the Instructions for the assessment of the educational activity of students of higher education at KhNMU (https://knmu.edu.ua/doc_block_type/instrukcziyi-navchalnogo-proczesu/). The grade for a class or module is from 2 to 5 points. Submission of tasks late for disrespectful reasons entails a decrease in the score according to the percentage of time delay from the time of completion of the task. Tasks are checked within 24 hours. Scores are submitted to the electronic journal. Unsatisfactory grades are worked out in accordance with the Regulation on the procedure for students of KhNMU to study classes (chrome-extension://efaidnbmnmnibpajpcglefindmkaj/https://knmu.edu.ua/wp-content/uploads/2021/05/pol_por-vidprac-zaniat.pdf).

At the end of the study of the discipline, the grade for the current learning activity (CLA) is calculated; it is equal to the average score (arithmetic average) for all classes during two semesters. This average score is converted into a multi-point score (from 70 to 120 points).

Individual tasks (IT) are evaluated up to 10 points.

Final control. Graded credit (GC) from 50 to 80 points.

Grade in the discipline (GD). $GD=CLA+GC+IT$

Appealing the results of the final control is carried out in accordance with the procedure established in KhNMU (https://knmu.edu.ua/wp-content/uploads/2021/05/polog_apel_kontrol.pdf).

POLICIES OF THE EDUCATIONAL COMPONENT

Recommendations for working on the course: Students are encouraged to actively participate in all forms of class activities, dedicate 1–2 hours daily to independent work and preparation for classes, ask questions during sessions, attend consultations, submit assignments on time, and complete all forms of assessment.

Attending classes. Attendance at lectures and practical classes is mandatory. The required attire for in-person sessions is a white medical coat. When visiting clinical base departments, students must wear a surgical suit, cap, medical mask, and changeable footwear. Students arriving more than 5 minutes late may be denied entry to the class. Missed classes must be made up in accordance with the *Regulations on the Procedure for Making Up Classes by Students at KhNMU* (https://knmu.edu.ua/wp-content/uploads/2021/05/pol_por-vidprac-zaniat.pdf).

Academic integrity. KhNMU stands on the positions of zero tolerance to manifestations of academic dishonesty. Any violations of the principles of academic integrity entail responsibility in accordance with the procedure established by KhNMU (https://knmu.edu.ua/wp-content/uploads/2021/05/polog_ad-1.pdf).

Use of electronic gadgets and artificial intelligence tools. Use of electronic devices and AI tools is permitted only with the teacher's approval.

Policy on persons with special educational needs. Students with special educational needs should contact the teacher to develop an individualized educational trajectory.

Teacher Response Time: 24 hours.

Technical requirements for the course:

- access to a computer, laptop, tablet or smartphone
- Corporate Google account with your own photo
- skills in working with Google Workspace (Google Meet, Docs, Sheets, Slides, Forms) and Moodle
- actively engage in all forms of in-class work, dedicate 1-2 hours daily to independent study and preparation for classes, ask questions during lessons, attend consultations, submit assignments on time, and complete all forms of assessment

Technical support: ASM (ev.shevtsov@knu.edu.ua), Google (tehotdelknu@gmail.com), Moodle (al.korol@knu.edu.ua)

RECOMMENDED SOURCES

1. “Biological and Bioorganic Chemistry: in 2 books. Book 1. Bioorganic Chemistry / B. S. Zimenkovsky, V. A. Muzychenko, I. V. Nizhenkovska, G. O. Syrova. – 3rd ed. – Kyiv: AUS Medicine Publishing, 2020. – 288 p. – ISBN 978-617-505-791-9.
2. “Bioorganic and Medicinal Chemistry” / Mangesh Pandurang Dushing, Varsha Tekdas Shewate, Preeti Soni, Prashant Mundeja. – Academic Guru Publishing House, 2024. – 235 p.
3. “Bioorganic and Medicinal Chemistry: e-Book for B.Sc 2nd Sem” / Neeraj Kumar Tripathi, Rajesh Chandra Verma. – Thakur Publication Private Ltd., 2022. – 416 p.

Head of Department
of Medical and Bioorganic Chemistry

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