

**MINISTRY OF HEALTH OF UKRAINE  
ODESA NATIONAL MEDICAL UNIVERSITY**

**Faculty of medicine, international**

**Department of Medical Biology and Chemistry**

**Syllabus of the academic discipline  
"Medical chemistry"**

<b>Scope of the academic discipline</b>	Total hours: 90 hours, 3.0 credits. 1 <sup>st</sup> semester of the 1 <sup>st</sup> course.
<b>Days, time, place of educational discipline</b>	According to the schedule of classes. Department of clinical chemistry and laboratory diagnostics.  Odesa, str. Olgiivska, 4a, Department of Medical Biology and Chemistry, 2st floor.
<b>Teachers</b>	Associate professors: Ph.D. Burdina Y.F., Ph.D. Shirykalova A.O., Ph.D. Grekova A.V. Assistant: Gridina I.R.
<b>Contact Information</b>	Phone consultations: Burdina Yanina Fedorivna, head teacher of the department 066-293-57-57 Grekova Alla Vasylivna, responsible for organizational and educational work of the department 097-938-30-52 Tatyana Petrivna Troyan, senior laboratory technician of the department (048) 728-54-78 E-mail: medchem@ukr.net Offline consultations: from 2:00 p.m. to 5:00 p.m. every Thursday, from 9:00 a.m. to 2:00 p.m. every Saturday. Online consultations: from 4:00 p.m. to 6:00 p.m. every Thursday, from 9:00 a.m. to 2:00 p.m. every Saturday. The link to the online consultation is provided to each group during classes separately.

**COMMUNICATION**

Communication with applicants will be carried out in the classroom (in person).

During distance learning, communication is carried out through the Microsoft Teams platform, as well as through e-mail correspondence, Viber, Telegram, WhatsApp messengers (through the created groups for each group, separately through the group head).

**ABSTRACT OF THE EDUCATIONAL DISCIPLINE**

*The subject of studying the discipline is to provide the medical student with the necessary knowledge to understand the functions of individual body systems, the interaction of the body with the environment, as well as the ability to use various quantitative calculations to analyze certain processes.*

*Prerequisites and post-requisites of the discipline (place of the discipline in the educational program):*

*Prerequisites:* Ukrainian language (by professional direction), foreign language (by professional direction), chemistry (general course)

*Postrequisites:* bioorganic chemistry, biophysics, medical biology, physiology, pathophysiology, biological chemistry, pharmacology, hygiene and ecology.

*The goal of the discipline:* systematize knowledge of the fundamental theoretical chemistry, learn to actively apply this knowledge to reveal the physico-chemical cause of phenomena that occur in a living organism under normal conditions and during pathological changes, as well as when the body is affected by environmental factors: chemo - and physiotherapeutic means.

*Tasks of the discipline:*

1. To teach students basic chemical concepts, concepts, principles to understand and evaluate the physical and chemical processes of a living organism;

2. To reveal practical aspects of chemical experiments, ways and methods of using chemical research in medical practice;

3. To create a fundamental scientific basis for future doctors in understanding the general physical and chemical laws underlying the processes of human life.

Expected results:

*As a result of studying the academic discipline, the applicant must:*

**To know:** the scientific pillars of the general physico-chemical interactions that are primary for the human life.

**Be able to:**

- Demonstrate knowledge in practical situations;
- Use the acquired knowledge and the understanding of the subject domain and profession;
- Understand self-regulation and lead a healthy lifestyle, the ability to adapt and act in a new situation;

- Be aware of the choice of communication strategy; the ability to work in a team; interpersonal skills;

- Communicate effectively, formulate and solve tasks both orally and written;

- Use some information and communication technologies;

- Apply methods of analysis of design and research, as well as their limitations in accordance with specialization;

- Analyze and evaluate chemical processes, choose and apply a suitable method: analytical, calculation or experimental, interpret research results;

- Use practical skills to solve complex tasks of implementing chemical and biological projects and conducting research in accordance with specialization;

- Collect, interpret relevant data and analyze complexities within specialization to make judgments that highlight social and ethical issues;

- Efforts to preserve the environment;

- Demonstrate the current level of knowledge of specialized issues in medical chemistry in relation to solving medical problems;

- Analyze and interpret the physical and chemical processes taking place in the human body.

## DESCRIPTION OF THE EDUCATIONAL DISCIPLINE

*Forms and methods of education*

The discipline will be taught in the form of lectures (14 hours), practical (32 hours), organization of independent work of the applicant (44 hours).

*Teaching methods*

**Lectures:** lectures with the use of multimedia presentations.

**Practical classes:**

- verbal methods: conversation, explanation, discussion, discussion of problem situations;
- visual methods: illustration (including multimedia presentations).

**Independent work:** independent work with the recommended basic and additional literature, with electronic information resources, preparation for practical classes; independent solution of situational problems.

**Content of the academic discipline****Topic 1. Chemistry of Biogenic Elements. Chemical Elements in Living Organisms.**

General information about biogenic elements. Qualitative and quantitative content of biogenic elements in the human body.

**Topic 2. Biological Role and Medical Applications of Biogenic s-, p-, and d-Elements. Qualitative Reactions for the Detection of s-, p-, and d-Elements.**

The structure of atoms of s-, p-, d- elements based on their position in the periodic table of elements (PSE). Topography of s-, p-, d- elements in the human body and biological role.

**Topic 3. Werner's Coordination Theory and the Structure of Complex Compounds. Applications of Complex Compounds in Medicine.**

Complexation reactions. A. Werner's coordination theory and modern ideas about the structure of complex compounds. Complexones and their use in medicine as antidotes for heavy metal poisoning (chelation therapy) and as antioxidants for the storage of medicinal products.

**Topic 4. Basic concepts of chemical thermodynamics.**

Living organisms are open thermodynamic systems. Irreversibility of life processes. Thermochemical calculations for estimating the caloric content of food products and making rational and therapeutic diets. Application of the basic principles of thermodynamics to living organisms. ATP as a source of energy for biochemical reactions.

**Topic 5. Physicochemical Foundations of Kinetics and Catalysis. Kinetics of Enzymatic Reactions. Application of Enzyme Preparations in Medicine.**

Chemical kinetics as a basis for studying the rates and mechanism of biochemical reactions. Insights into the kinetics of enzymatic reactions. Enzymes as biological catalysts.

**Topic 6. Chemical Equilibrium. Influence of External Factors on the Shift of Chemical Equilibrium. Equilibrium in Heterogeneous Systems.**

The role of heterogeneous balance with the participation of salts in the general homeostasis of the body.

**Topic 7. Electrochemistry and Electrochemical Methods of Investigation in Medicine.**

The role of electrochemical phenomena in biological processes. Diffusion potential. Membrane potential. Biological role of diffusion and membrane potentials. Potential for damage. The potential for peace. Action potential.

***Topic 8. Modern Concepts of Solutions. Quantities Characterizing the Qualitative Composition of Solutions.***

Classification of methods of quantitative analysis. Basic calculation formulas. The role of solutions in the vital activity of organisms. Classification of solutions. Mechanism of dissolution processes. Thermodynamic approach to the dissolution process.

***Topic 9. Equilibrium in Electrolyte Solutions. Electrolytic Dissociation in Solutions of Strong and Weak Electrolytes. pH of Biological Fluids.***

Electrolyte solutions. Electrolytes in the human body. Water-electrolyte balance is a necessary condition for homeostasis. pH intervals for body biofluids in normal and pathological conditions. Acidosis. Alkalosis. The role of electrolytes in life processes.

***Topic 10. Colligative Properties of Dilute Solutions. Osmometry, Cryometry, Ebulliometry. The Role of Osmosis in Biological Systems.***

Colligative properties of dilute solutions of non-electrolytes. The role of osmosis in biological systems. Osmotic pressure of blood plasma. Haller's equation. Oncotic pressure. Plasmolysis and hemolysis.

***Topic 11. Buffer Solutions. Types of Buffer Systems and pH Calculation. Buffer Systems of the Body. Acid-Base Balance of the Body.***

Classification of buffer solutions. Buffer capacity and its dependence on various factors. Protein buffer systems. The concept of the acid-base state of blood. Buffer capacity and its dependence on various factors. Buffer capacity as a quantitative characteristic of buffer effectiveness.

***Topic 12. Physicochemical Chemistry of Surface Phenomena. Adsorption at Phase Boundaries. Chromatography.***

Surface phenomena and their significance in biology and medicine.

***Topic 13. Physical Chemistry of Dispersed Systems. Classification and General Properties of Dispersed Systems.***

The organism as a complex set of dispersed systems. Application of electrophoresis in research and clinical laboratory practice. Suspensions, production methods and properties. Pastes, their medical use. Emulsions, production methods and properties. Application of emulsions in clinical practice.

***Topic 14. Macromolecules and Their Solutions.***

Globular and fibrillar structure of proteins. Comparative characteristics of solutions of high molecular weight compounds, true and colloidal solutions.

***Topic 15. Nanochemistry in the Modern World.***

Nanomaterials for Molecular Imaging and Early Disease Diagnosis. Advantages and Limitations of Using Nanomaterials in Diagnostics. Targeted Drug Delivery Using Nanomaterials. Development and Use of Nanomaterials for the Treatment of Cancer and Cardiovascular Diseases.

***Topic 16. Differentiated credit test.***

*List of recommended literature:*

**Base literature:**

1. Medical chemistry / V.O. Kalibabchuk, V.I. Halynska, L.I. Hryshchenko et al. – Kyiv, AUS Medicine Publishing, 2020. – 224 p.
2. Medical Chemistry: textbook / V.Y. Tsuber, A.A. Kotvytska, K.V. Tykhonovych et al. – Kyiv, AUS Medicine Publishing, 2022. – 392 p.
3. General and Inorganic Chemistry: textbook / V.O. Kalibabchuk, V.V. Ohurtsov, V.I. Halynska et al. – Kyiv, AUS Medicine Publishing, 2019. – 456 p.

**Additional literature:**

1. Textbook of Medicinal Chemistry / V. Alagarsamy // CBS Publishers & Distributors Pvt Ltd, India; 3rd edition, 2018 – 584 p.
2. Richard Post. Chemistry: Concepts and Problems / Richard Post, Chad Snyder, Clifford C. Houk // A Self-Teaching Guide, Jossey-Bass, 2020. – 432 p.
3. Darrell D. Ebbing. General Chemistry / Darrell D. Ebbing, Steven D. Gammon. – Boston: Cengage Learnin, 2017. – 1190 c.

**EVALUATION**

**Current control:** oral survey, assessment of performance of practical skills, solution of situational tasks, assessment of activity in class.

**Differentiated assessment** is carried out with the help of written work (tasks and exercises, the performance of which requires mandatory knowledge, as well as situational tasks): 2 tasks of the II level of difficulty and 3 tasks of the III level of difficulty.

**Criteria for ongoing assessment in the practical lesson:**

<b>Score</b>	<b>Assessment criterion</b>
Excellent «5»	The student is fluent in the material, takes an active part in the discussion and solution of the situational problem, confidently demonstrates practical skills in the interpretation of laboratory tests, expresses his opinion on the topic of the lesson.
Good «4»	The student is well versed in the material, participates in the discussion and solution of the situational problem, demonstrates practical skills during and interpretation of laboratory tests with some errors, expresses his opinion on the topic of the lesson.
Satisfactory «3»	The student does not have enough material, uncertainly participates in the discussion and solution of a situational problem with significant errors.
Unsatisfactory «2»	The student does not have the material, does not participate in the discussion and solution of the situational problem, does not demonstrate practical skills.

**A student is admitted to a differentiated test if he/she fulfills the requirements of the curriculum and if he/she has received at least 3.00 points for the current educational activity.**

**The structure of the differential test**

The content of the evaluated activity	Number of questions
The answer to theoretical questions.	2
Practical task	3

Total	5
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**Criteria for assessing the learning outcomes of students on a differentiated test:**

Excellent «5»	Exhibited to a student who worked systematically during the semester, showed during the differential test comprehensive and deep knowledge of the program material, is able to successfully perform the tasks provided by the program, mastered the content of basic and additional literature, realized the relationship of individual sections of the discipline, their importance for future profession , showed creative abilities in understanding and using educational material, showed the ability to independently update and replenish knowledge; level of competence - high (creative);
Good «4»	It is presented to a student who has shown full knowledge of the curriculum, successfully performs the tasks provided by the program, mastered the basic literature recommended by the program, showed a sufficient level of knowledge of the discipline and is able to independently update and update during further study and professional activities; level of competence - sufficient (constructive-variable)
Satisfactory «3»	Exhibited to a student who has shown knowledge of the basic curriculum in the amount necessary for further study and further work in the profession, copes with the tasks provided by the program, made some mistakes in answering the differential test and tasks, but has the necessary knowledge to overcoming mistakes; level of competence - average (reproductive)
Unsatisfactory «2»	Exposed to a student who did not show sufficient knowledge of the basic curriculum, made fundamental mistakes in performing the tasks provided by the program, can not without the help of the teacher to use the knowledge in further study, failed to master the skills of independent work; level of competence - low (receptive-productive)

Thus, the department publishes two grades:

- 1) the arithmetic mean of all current grades (calculated as a number rounded to 2 (two) decimal places);
- 2) traditional grade for differentiated credit.

The average score for the discipline (traditional grade) is calculated as the arithmetic average of the current performance and the grade obtained on the differentiated test.

Further calculations are made by the information and computing center of the university.

**INDEPENDENT WORK OF HIGHER EDUCATION ACQUIRES**

Independent work involves preparation for each practical session.

**EDUCATIONAL DISCIPLINE POLICY**

**Policy on Deadlines and Retakes:** Students are expected to attend all lectures and practical classes. If a class is missed, it must be made up according to the schedule posted on the department's information board and in accordance with the dean's office's permission if required. Retakes for unsatisfactory grades are allowed in the final month of the course if the average grade for current academic performance is less than 3.00 (conducted according to the schedule posted on the department's information board). The differentiated assessment is conducted during the final class of the course. A student is eligible for the differentiated assessment if they have attended all classes and have an average grade of at least 3.00 for current academic performance.

**Policy on Academic Integrity.**

Students are expected to maintain academic integrity, which includes:

- Completing assignments, ongoing assessments, and differentiated assessments independently (for students with special educational needs, this requirement is applied considering their individual needs and capabilities).
- Citing sources when using ideas, developments, statements, or information.
- Complying with copyright and related rights laws.
- Providing accurate information about their own (scientific or creative) work, research methods used, and sources of information.

**Unacceptable behaviors in academic activities include:**

- Using family or professional connections to obtain a positive or higher grade during any form of assessment or to gain advantages in scientific work.
- Using prohibited supplementary materials or technical devices (crib sheets, notes, earpieces, phones, smartphones, tablets, etc.) during assessments.
- Having another person take an assessment on behalf of the student. Students who violate academic integrity may face the following academic consequences.
- Lowering of the evaluation results for an assessment, exam, or test.
- Retaking an assessment (exam, test, etc.).
- Assignment of additional control measures (additional individual tasks, tests, etc.).
- Retaking the relevant educational component of the program.
- Additional checks of other works authored by the violator.

**Policy on Attendance and Tardiness:** Health: Students with acute infectious diseases, including respiratory illnesses, are not allowed to attend classes. Tardiness to class is not acceptable. A student who is late to class may still attend, but if the instructor marks "absent" in the journal, the student must make up for the missed class according to general procedures.

**Use of Mobile Devices:** The use of mobile devices is prohibited. If this rule is violated, the student must leave the class, and the instructor will mark "absent," which the student must make up according to the standard procedure. Mobile devices may be used with the instructor's permission if they are required for the task.

**Classroom Behavior:** The behavior of both students and instructors in the classroom must be professional and calm, strictly following the rules set out in the Regulations on Academic Integrity and Ethics of Academic Relations at Odessa National Medical University, in accordance with the University's Code of Academic Ethics and Relations, and the Regulations on Preventing and Detecting Academic Plagiarism in the Scientific and Educational Work of Students, Researchers, and Instructors at Odessa National Medical University.