

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

Faculty of medicine, international

Department of Medical Biology and Chemistry

**Syllabus of the academic discipline
"Applied chemistry in medicine"**

Scope of the academic discipline	Total hours per discipline: 90 hours, 3.0 credits. Semesters:I. 1 year of study.
Days, time, place of educational discipline	According to the schedule of classes. Department of clinical chemistry and laboratory diagnostics. Odesa, st. Olgiivska, 4a, Department of Clinical Chemistry and Laboratory Diagnostics, 1st floor.
Teacher(s)	Associate professors: Ph.D. Burdina Y.F., Ph.D. Grekova A.V., Ph.D. Shirykalova A.O. Assistant: Gridina I.R.
Contact Information	Help by phone: 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 Tetyana Petrivna Troyan, senior laboratory technician of the department (048) 728-54-78 Email:medchem@ukr.net Face-to-face 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 conducted in the classroom (face-to-face).

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

ABSTRACT OF THE ACADEMIC DISCIPLINE

Subject of study disciplines are arming a medical student with the knowledge necessary 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), "Medical Chemistry", "Bioorganic Chemistry" disciplines.

Post-requisites: bioorganic chemistry, biophysics, medical biology, physiology, pathophysiology, biological chemistry, pharmacology, hiit and ecology.

Purpose of the discipline: the formation of doctors' systematic knowledge of the basic physico-chemical patterns of the course of biochemical processes and the action of drugs in the body of each person at the molecular and cellular levels; structure and properties of colloidal dispersion systems; structure and functioning mechanisms of biologically active compounds; structure and functioning mechanisms of polymers; show the importance of chemistry in life, the specifics of using chemicals in household processes, the impact of synthetic chemicals on the environment; the ability to conduct research in various sections of modern applied chemistry.

Tasks of the discipline: increasing the level of theoretical training of students, the ability to use statistical methods for processing and analyzing data of medical and biological research; the student's understanding of the content of chemical phenomena occurring in the living organism, the use of chemical laws in the diagnosis and treatment of diseases, the ability to understand the physico-chemical principles of action of drugs used in modern medicine; study of physicochemical aspects of the most important biochemical processes and homeostasis in the body; study of acid-base properties of body biofluids; development of students' skills in studying scientific chemical literature; development of students' abilities to solve problematic and situational tasks; - formation and development of students' practical skills in staging and performing experimental work;

Expected results:

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

Know:

1. Application and general methods of synthesis of the main types and classes of bioactive organic and inorganic compounds.
2. Features of the structure, isomerism, characteristic properties of the main classes of bioorganic compounds and methods of their identification.
3. Stereochemical features and their influence on the biological properties of substances.
4. Basics of vital mechanisms at the molecular level.
5. The main stages of biotransformation of medicines in the body.
6. Basic gases and gas mixtures used in medicine; safety rules when using them.
7. Toxic elements for the human body, mechanisms of poisoning by chemical elements and drugs.
8. Composition and mechanisms of influence of component drinks on the human body.
9. The main composition of food products; food additives and their properties.
10. Basic polymer materials used in medicine. Concept of biocompatibility of polymeric materials.
11. Types of nanoparticles, their structure and properties. The main ways of using non-materials in medicine.

Be able:

1. Use educational, scientific, popular science and reference literature, the Internet
2. Predict the results of chemical transformations of inorganic and organic compounds
3. To judge the probability and direction of biochemical reactions
4. Orientate yourself in the ways of creating medicinal products from the synthesis of a substance to the approval of a finished medicinal product in the order of its certification
5. Orientate yourself in the real situation on the Ukrainian market of medicines, biologically active supplements
6. Characterize solutions of non-electrolytes and electrolytes, calculate their concentration

7. Interpret general medicinal preparations, their physico-chemical laws, which are the basis of the vital processes of the human body
8. Apply chemical methods of quantitative and qualitative analysis
9. Characterize the quantitative composition of solutions
10. Draw conclusions about the acidity of biological fluids based on the hydrogen indicator
11. Explain the mechanism of action of buffer systems and their role in maintaining acid-base balance in biosystems
12. Explain the mechanism of action of enzymes and analyze the dependence of the speed of enzymatic processes on the concentration of the enzyme and the substrate
13. Interpret the physicochemical properties of proteins, which are structural components of all body tissues, draw conclusions about the charge of dissolved biopolymers

DESCRIPTION OF THE ACADEMIC DISCIPLINE

Forms and methods of education:

The discipline will be taught in the form of practical classes (30 hours), organization of the applicant's independent work (60 hours).

Teaching methods:

Practical training:

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

Individual work: independent work with 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. Toxicologically important substances: inorganic, organic and carcinogenic compounds, metals, teratogens and addictive substances.

Selected inorganic substances - ozone, silicon oxide, hydrocyanic acid, carbon monoxide, nitrides, sulfides. Metals - cadmium, barium, mercury, lead. The selected organic compounds are benzene, toluene, polycyclic hydrocarbons, methanol, ethylene glycol. Carcinogenic substances.

Topic 2. Water in living systems. The role and content of water in the human body. Determination of general, temporary and permanent hardness of water.

Structure of water. Biological value of water. Water content in the human body. The role of water in the human body. Free and bound water in food products. Determination of total moisture content in food products. Determination of water hardness. Determination of temporary and permanent hardness of water.

Topic 3. Solutions. Preparation of solutions with a specified quantitative composition. Solutions for providing pre-medical care.

Solutions in life. Enthalpy and entropy factors of dissolution and their connection with the mechanism of dissolution. Solubility of liquids and solids. Distribution of substances between two immiscible liquids. Nernst distribution law, its importance in the phenomenon of permeability of biological membranes. Preparation of solutions of the given composition.

Topic 4. Solubility of drugs. Relationship between pharmacological activity and ionization of molecules. Infusion solutions.

The role of the influence of water on the pharmacological activity of drug molecules. Concept of drug solubility; influence of functional groups and carbon skeleton. Concentration of drug solutions. Recalculation of concentrations according to the written prescription. The effect of pH on the solubility of acidic and basic drugs. Ionization of molecules of biologically active compounds. Preparation of electrolyte solutions. Functional classification of infusion drugs and features of its use. Ionization constant and its effect on the pharmacological activity of molecules. Acid-base homeostasis. Acidosis and alkalosis. Buffer systems and their influence on the effect of medicinal products.

Topic 5. Medical solutions: antiseptics, disinfectant liquids. Water purification and sterilization of medical products and instruments in the field.

Hygiene of processing hands and work surfaces in case of viral and bacterial infections. Classification of antiseptic and disinfectant liquids. Algorithm for preparation of cleaning and disinfecting solutions. Water purification in the field. Means for disinfecting the surfaces of premises, medical products.

Topic 6. Medical gases: production, application and safety. Gas mixtures for inhalation anesthesia. Solubility of gases.

Properties of gases, gas laws. Air, its composition. Analysis of the composition of exhaled air for diagnostic purposes. Medical oxygen: production, operation, safety rules. Oxygen therapy. Mountain air, hypoxotherapy. Singlet oxygen therapy, ozone therapy. Noble gases in medicine. Gas mixtures for anesthesia. Xenon, production of medical xenon. Radonotherapy. Solubility of gases in liquids and its dependence on various factors. Henry-Dalton law. The influence of electrolytes on the solubility of gases (Sechenov's law). Solubility of gases in blood. Bends.

Topic 7. Surfactants and their importance in human life. Chemistry of surfactants and detergents (synthetic detergents, shampoos, gels, bath foams).

Surface-active substances of biological origin. The influence of surfactants on the human body. Effect of surfactants on living systems. Classification of surfactants and their action in synthetic detergents. Shampoos: classification, properties, application. The mechanism of the washing action of foaming cosmetics. Compositions of surfactants in the cosmetic industry. A typical formulation of skin care products for the face and body: moisturizing creams, nourishing creams, creams with biostimulating and regenerating properties, day and night creams, preparations for the treatment of acne, protective creams against sunburn, hand creams, lotions. A typical formulation of decorative cosmetics: lipsticks, mascara, foundation. Shaving products. Toothpastes. Special soaps. Deodorants. Shampoos, shower gels. Compositions of food surfactants. Composition of monoglycerides and mixtures of mono- and diglycerides. Typical emulsifying compositions.

Topic 8. High molecular compounds. Properties and features of biopolymer solutions. The use of solutions of the HMC in medical practice.

Classification of the HMC. Natural high molecular weight compounds. Structural organization of biopolymers. Comparative characteristics of solutions of HMC, true and colloidal solutions. Swelling and dissolution of polymers. Medical properties of solutions of HMC. Ionic state of biopolymers in aqueous solutions. Isoelectric state of proteins. Teasing Properties of gels. Abnormal viscosity of solutions of the HMC. Blood viscosity. Donnan's membrane equilibrium.

Topic 9. Polymers for medical and biological applications: structure and functions. Medical and pharmaceutical application of polymeric materials.

Biopolymers in medical practice: bioinert (polysiloxanes, polyacrylates, polyethylene, polyamides, polyurethanes, polyesters), natural (collagen and gelatin, fibrin, polysaccharide hydrogels, cellulose fibrous composites, glycosaminoglycans, alginates, chitin and chitosan, dextran), bioabsorbable (biodegradable). Sterilization of polymer implants. Polymers used in reconstructive surgery, cardiovascular surgery, traumatology and orthopedics, ophthalmology. Polymer devices for targeted drug delivery. Polymer suture materials and polymer adhesives for medical purposes. Blood and plasma substitutes. Prolongers. Packaging materials for medicines and medical products.

Topic 10. Chemical quality control of drinks.

Human health and beverage safety issues. Natural components of food raw materials that have a negative effect on the human body. Social toxicants. Standardization of pollutants in beverages. The influence of drinks on taking medicines.

Topic 11. Food products, their quality.

Chemistry of food additives, preservatives, dietary supplements. Human health and food safety issues. Potentially dangerous food contaminants and their effects.

Topic 12. Sorption of biologically active substances at the boundary of phase separation. Adsorbents in modern medicine. Sorbents for food poisoning. Chromatography.

Sorbents and enterosorbents. Pharmacological properties of carbon enterosorbents. Adsorption of acetic acid on activated carbon. Principles of acute poisoning treatment. The main antidotes. Classification of chromatographic methods of analysis according to the distribution mechanism. Adsorption, ion exchange and distribution chromatography. Application of chromatography in medical and biological research.

Topic 13. Chemical weapons. Protective equipment and first aid.

Personalities of chemical weapons. Characteristics of the center of chemical contamination. Exposure to military poisons, countermeasures.

Topic 14. Fundamentals of nanochemistry. Nanotechnology in medicine.

Basic concepts and terms of nanochemistry. Classification of nanoobjects. Methods of synthesis of nanoparticles. Carbon nanomaterials. Porous nanoobjects. Liposomes. The role of nanotechnology in the diagnosis of diseases. Nanodevices - nanorobots. Use of nanosystems as drug carriers. Use of nanotechnology in oncology, neurology, cardiology and other fields of medicine. Nanocosmetics.

Topic 15. Final control of knowledge: credit.

12. Literature

Basic literature:

1. The Chemistry of Medical and Dental Materials, 2nd Edition By John W. Nicholson 2020. Published by the Royal Society of Chemistry -251 p. - ISBN: 978-1-78801-530-1
2. Narayan R. (Ed.) Biomedical Materials 2nd Edition. — Springer, 2021. — 720 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.
4. William Marshall, Marta Lapsley, Andrew Day, Kate Shipman. Clinical Chemistry. – Elsevier, 2020, - 432 p.
5. Textbook of Medicinal Chemistry / [V. Alagarsamy](#) // CBS Publishers & Distributors Pvt Ltd, India; 3rd edition, 2018 – 584 p.
6. Richard Post. Chemistry: Concepts and Problems / Richard Post, Chad Snyder, Clifford C. Houk // A Self-Teaching Guide, Jossey-Bass, 2020. – 432 p.

7. Darrell D. Ebbing. General Chemistry / Darrell D. Ebbing, Steven D. Gammon. – Boston: Cengage Learnin, 2017. – 1190 c. – (Eleventh Edition).

Additional literature:

1. Medical Biochemistry/ Baynes J., Dominiczak M.. – Saunders, Elsevier, 2018. – 712 p.
2. Lippincott Illustrated Reviews: Biochemistry/Ferrier D. – Philadelphia :Wolters Kluwer, 2017. – 560 p.
3. Medical Chemistry: textbook / V.Y. Tsuber, A.A. Kotvytska, K.V. Tykhonovych et al. – Kyiv, AUS Medicine Publishing, 2022. – 392 p.
4. Medical chemistry: a textbook for universities / V. O. Kalibabchuk, I. S. Chekman, V. I. Galynska and others; for ed. Prof. V. O. Kalibabchuk – 4th ed. – K. VSV "Medicine", 2019 – 336 p.
5. Medical chemistry / V.O. Kalibabchuk, V.I. Halynska, L.I. Hryshchenko et al. – Kyiv, AUS Medicine Publishing, 2020. – 224 p.

13. Electronic information resources

1. <http://moz.gov.ua> - Ministry of Health of Ukraine
2. www.who.int - World Health Organization
3. www.dec.gov.ua/mtd/home/ - State Expert Center of the Ministry of Health of Ukraine
4. <http://bma.org.uk> - British Medical Association
5. www.gmc-uk.org - General Medical Council (GMC)
6. www.bundesaerztekammer.de - German Medical Association

ASSESSMENT

Current control: oral survey, testing, control of learning practical skills, solving situational clinical tasks, assessment of activity in class.

Final control: balance

Crediting is carried out in the last class after the end of the practical classes before the beginning of the examination session.

The structure of the current assessment in the practical session:

1. Evaluation of theoretical knowledge on the subject of the lesson:
 - methods: survey, written work, solving a situational problem, solving test problems;
 - the maximum score is 5, the minimum score is 3, the unsatisfactory score is 2.
2. Assessment of the acquisition of practical skills:
 - methods: methods: survey, solving a situational problem, solving test problems.

Current assessment criteria for practical training:

5"	The student is fluent in the material, takes an active part in discussing and solving the situational problem, confidently demonstrates practical skills during the interpretation of laboratory research, expresses his opinion on the subject of the lesson
4"	The student has a good command of the material, participates in the discussion and solution of the situational problem, demonstrates practical skills during and interpreting laboratory studies with some errors, expresses his opinion on the subject of the lesson.
3"	The student does not have sufficient knowledge of the material, is unsure of participating in the discussion and solving the situational problem with significant errors.
2"	The student does not master the material, does not take part in the discussion and solution of the situational problem, does not demonstrate practical skills.

A student is admitted to the final examination provided that he/she attends all classes, has no academic debt, and if the average score for the current academic activity is at least 3.00.

Students who have completed the curriculum in the discipline in full, have no academic debt, have a current grade point average of 3.00 or more, and receive a credit in the last class, which is presented as "passed" / "failed".

Conversion of the traditional national assessment into multi-point (maximum 200 points) is mandatory.

9. Distribution of points received by students of higher education

The average score for the discipline is translated into a national score and converted into points on a multi-point scale(200-point scale).

The conversion of a traditional grade into a 200-point grade is performed by the information and technical department of the University using the "Contingent" program according to the formula:

$$\text{Average success score (current success in the discipline)} \times 40$$

Table of conversion of traditional assessment to multi-point assessment

National assessment for discipline	The sum of points for the discipline
Excellent ("5")	185 - 200
Good ("4")	151 - 184
Satisfactory ("3")	120-150
Unsatisfactory ("2")	Below 120

According to the ECTS rating scale, the achievements of students in the educational component who study in the same course of the same specialty are evaluated, according to the points they received, by ranking, namely:

Conversion of the traditional grade from the discipline and the sum of points on the ECTS scale

Evaluation on the ECTS scale	Statistical indicator
A	Top 10% achievers
B	The next 25% of earners
C	The next 30% of earners
D	The next 25% of earners
E	The next 10% of earners

INDEPENDENT WORK OF STUDENTS OF HIGHER EDUCATION

Independent work involves preparation for each practical session.

POLICY OF EDUCATIONAL DISCIPLINE

Deadlines and Rescheduling Policy:

Applicants are expected to attend all practical sessions. If they missed the class, it is necessary to make up for it (according to the schedule posted on the information stand of the department and according to the permission of the dean's office, if it is needed).

Unsatisfactory grades are rewritten during the study of the subject under the conditions that the average score for the current educational activity is less than 3.00 (it is carried out according to the schedule posted on the information stand of the department).

Assessment is carried out at the last lesson of studying the discipline. A student is admitted to the course on the condition that he attends all classes and has an average score for the current educational activity of at least 3.00.

Academic Integrity Policy:

Observance of academic integrity by students of education involves:

- independent performance of educational tasks, tasks of current control and differential assessment (for persons with special educational needs, this requirement is applied taking into account their individual needs and capabilities);
- references to sources of information in case of use of ideas, developments, statements, information;
- compliance with the legislation on copyright and related rights;
- provision of reliable information about the results of one's own (scientific, creative) activity, used research methods and sources of information.

Unacceptable in educational activities for participants of the educational process are:

- family or official useconnections to obtain a positive or higher grade during the implementation of any form of control of learning results or advantages in scientific work;
- the use of prohibited auxiliary materials or technical means (cheat sheets, notes,headsets, phones, smartphones, tablets, etc.);
- going through procedures for monitoring the results of training by fake persons.

For violation of academic integrity, students may be held to the following academic responsibility:

- decrease in the evaluation results of the control work, exam, credit, etc.;
- retaking the assessment (test, exam, credit, etc.);
- assignment of additional control measures (additional individual tasks, control works, tests, etc.);
- repeating the corresponding educational component of the educational program;
- conducting an additional inspection of other works authored by the violator.

Attendance and Tardiness Policy:

Attending practical classes is mandatory. If you are late for more than 15 minutes, the lesson is considered missed and you need to make up for it.

Mobile devices:

During practical classes, the use of a smartphone, tablet or other device for storing and processing information is allowed only with the teacher's permission.

During any form of control, the use of mobile devices and their accessories is strictly prohibited.

Behavior in the audience:

The behavior of applicants and teachers in the classrooms should be working and calm, strictly comply with the rules establishedRegulations on academic integrity and ethics of academic relations at Odessa National Medical University, in accordance withCode of Academic Ethics and Relations of the University Community of Odessa National Medical University,Regulation on prevention and detection of academic plagiarism in research and educational work of higher education applicants, scientists and teachers of Odesa National Medical University.