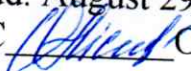




**INTERNATIONAL EUROPEAN UNIVERSITY**  
**EDUCATIONAL AND RESEARCH INSTITUTE**  
**"EUROPEAN MEDICAL SCHOOL"**

**Department of Fundamental, Medical and Preventive  
Disciplines**

**APPROVED** by  
The Scientific and Methodical Council of the  
University, protocol dd. August 29, 2023 No. 7  
Deputy Chair of SMC  O. LISNICHUK

**WORKING PROGRAM OF THE ACADEMIC DISCIPLINE:**  
**MEDICAL CHEMISTRY**  
to train students of the second (Master's) level  
(full-time mode of study)

**Knowledge area 22 "Health care"**

**Specialty 222 "Medicine"**

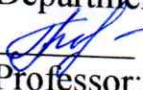

**Educational program: Medicine**

**Discipline status: Compulsory**

Kyiv – 2023

The working program of the **Medical chemistry** academic disciplines is based on the Medicine educational and professional program for the second (Master) level of the 222 Medicine specialty approved by the University Academic Council on May 30, 2023, protocol №4.

PROGRAM DEVELOPER:


Associate Professor of the Department of Fundamental and Medical Preventive Disciplines  O. HOLODAEVA,  
Ph.D in chemistry, Associate Professor;  
Teacher of the department of fundamental and medical and preventive disciplines  R. PAVLENKO

REVIEWER:


Associate Professor of the Department of Fundamental and Medical Preventive Disciplines  L. Bidna, PhD in chemistry,  
Associate Professor

Guarantor of EP  A. BONDARENKO

The working program of the academic disciplines is reviewed and approved by the Department of Fundamental, Medical and Preventive Disciplines, protocol No. 1 dd. August 25, 2023.

Head of the Department of Fundamental, Medical and Preventive Disciplines, PhD in biology, Associate Professor  Victoria KOVALENKO

The program is reviewed and approved by the Academic Council of the European Medical School, protocol No. 1 dd. August 29, 2023.

Chair of the Academic Council  
of the European Medical School  
Ph.D in Medicine,  
associate professor  Yevhenii SIMONETS

## INTRODUCTION

**The study program of the academic discipline "Medical Chemistry"** is compiled in accordance with Standard of higher education of the second (master's) level of training of higher education applicants education of the educational degree "Master", field of knowledge 22 - "Health care", specialty - 222 "Medicine", educational and qualification level "Master of Medicine".

**Description of the academic discipline (abstract)** : "Medical chemistry" as an academic discipline is one with important discipline in system higher medical education Medical chemistry is a complex discipline that considers the basic concepts, provisions and laws of inorganic, analytical, physical and colloidal chemistry and their application in theoretical and practical medicine Study "Medical chemistry" provides to the student subsoil for mastery such disciplines, as physiology, medical biochemistry, microbiology, general and molecular pharmacology and toxicology, general hygiene and ecology. Systematic study of the most important theoretical questions of chemistry will enable students to apply them for revealing the essence of physical and chemical processes occurring in a living organism. This will help better assimilation by students of other theoretical and clinical disciplines, formation of them of scientific thinking. The training of specialists who need knowledge of medical chemistry requires not only theoretical training, but also versatile practical skills and skills in conducting chemical experiment

The study of the academic discipline "Medical Chemistry" is carried out by students in the 1st year for 1st semester

The educational process is organized according to the credit system in accordance with the requirements European credit transfer and storage systems.

Program disciplines structured on **three sections** .

Section AND. The main ones laws chemistry Bioinorganic chemistry

Section II. Solutions and their role in progress biochemical processes

Section III. Physico-chemistry superficial phenomenon Lyophobic and lyophilic dispersed systems

### Informative amount educational disciplines

Name indicators	Field of knowledge, direction training, educational - qualifying level	Characteristic educational disciplines
		daytime form teaching
<b>Number loans – 3.0</b>	Branch of knowledge 22 "Health care" Direction preparation "Medicine"	Normative Year preparation 1st
Content sections – 3	Specialty: 222 "Medicine"	Semester 1st
General number hours – 90		Lectures 4 p.m.
the total number of classrooms hours - 48		Practical 32 hours
Weekly load: classrooms - 3	Educational qualification level: "Master of Medicine" Qualifications professional "doctor"	Independent work 42 hours
		Type of control: Diff. settlement

**The subject of study of the academic discipline** is to arm the medical student with knowledge, necessary for understanding functions individual systems body, interaction body from surrounding environment, and also skills use various quantitative calculations for analysis of certain processes.

**Interdisciplinary connections:** Medicinal chemistry as an educational discipline: a) is based on studied by students of bioorganic chemistry, biophysics, medical biology and integrates with them disciplines; b) lays the foundations for the study of such medical and biological disciplines by students as: physiology, pathophysiology, biological chemistry, pharmacology, and also some clinical, hygienic discipline and ecology

## 1. GOAL AND EDUCATIONAL TASKS DISCIPLINES

1.1. **The goal** of teaching the academic discipline "Medical Chemistry" is the formation of students of knowledge about the main ones types chemical balance for formation holistic physical and chemical approach to study processes life activities body, and also be able apply chemical methods of quantitative and qualitative analysis, to be able to classify chemical properties and transformation bioinorganic substances in life process body

1.2. **The main ones tasks study disciplines** is creation fundamental scientific base future doctors in understanding them general physical and chemical regularities, which are the basis life processes a person

**1.3 Competences and the results teaching**, formation whose promotes discipline (relationship with normative content preparation acquirers higher education, formulated in terms of results study at Standards higher education).

According to requirements Standard higher education of Ukraine (second (master's) level higher education, branch of knowledge 22 "Protection health", specialty 222 "Medicine") discipline provides acquisition students of the following **competencies**:

- **integral:** ability integrate knowledge and to solve complex specialized tasks in wide and multidisciplinary contexts professional activity doctor, solve practical problems in new ones or strangers environments by availability incomplete or limited information, with taking into account aspects social and ethical responsibility in the industry Health Care.

- **general and professionals:**

<b>general competence (ZK)</b>	
<b>ZK 1.</b>	Ability to abstract thinking, analysis and synthesis.
<b>ZK 2.</b>	Ability to learn and master modern knowledge.
<b>ZK 3.</b>	Ability to apply knowledge in practical situations.
<b>ZK 4.</b>	Knowledge and understanding of the subject area and understanding of professional activity
<b>ZK 5.</b>	Ability to adapt and act in a new situation
<b>ZK 6.</b>	Ability to make informed decisions
<b>ZK 7.</b>	Ability to work in a team
<b>ZK 8.</b>	Ability to interpersonal interaction
<b>ZK 10.</b>	Ability to use information and communication technologies
<b>ZK 11.</b>	Ability to search, process and analyze information from
<b>ZK 12.</b>	Determination and persistence of delivered tasks and taken responsibilities
<b>Professionals competence (FC)</b>	
<b>FC 2.</b>	Ability to determine the necessary list of laboratory and instrumental studies and evaluate their results
<b>FC 17.</b>	The ability to assess the impact of the environment, socio-economic and biological determinants on the state of health of an individual, family, population
<b>FC 23.</b>	The ability to develop and implement scientific and applied projects in the field of health care.
<b>FC 24.</b>	Adherence to ethical principles when working with patients and laboratory animals
<b>FC 25.</b>	Adherence to professional and academic integrity, to be responsible for the reliability of the obtained scientific results
<b>Software the results teaching (PRN)</b>	

<b>PRN 1.</b>	Have thorough knowledge of the structure of professional activity. Be able to carry out professional activities that require updating and integration of knowledge. To be responsible for professional development, the ability for further professional training with a high level of autonomy
<b>PRN 2.</b>	Understanding and knowledge of basic and clinical biomedical sciences, on level sufficient for solving professional tasks in the field of health care
<b>PRN 21.</b>	to search necessary information in professional literature and databases data others sources , analyze , evaluate and apply this one information .
<b>PRN 24.</b>	To organize the required level of individual safety (own and the persons he cares for) in case of typical dangerous situations in the individual field of activity.

### The results teaching by discipline:

After mastery disciplines student should

#### know:

- Interconnection between biological role biogenic s-, p-, d- elements and formfinding them in the body.
- Principles structures complex compounds .
  - Features structures complex compounds as foundations for their application inchelation therapy .
- Characteristics quantitative composition solutions
  - Quantitative contents in solution acids and basics by help methods acid-basetitration.
  - Mechanism actions buffer systems and their role in support acid-base balance inbiosystems.
- Interconnection between colligative properties and concentration solutions
- Thermal effects chemical and biochemical processes.
  - Thermodynamic functions for evaluations orientation processes, explain energyconjugation in living systems.
- Dependence speed reactions from concentration and temperature
  - Conditions formation and dissolution sediments, explain role heterogeneous balance by participation salts in general homeostasis body
- Mechanism formation electrode potentials.
  - Features structures superficial layer adsorbed molecules surface-activecompounds , principles of the structure of biological membranes.
- Equation adsorption and limits their using.
- Regularities adsorption substances with solutions on solid surface
- Physico-chemical foundations methods adsorption therapy
- Principles methods obtaining and cleaning colloidally dispersed solutions
  - Physico-chemical properties proteins, what is structural components everyone fabricsbody

### Having mastered discipline "Medical chemistry" student should be able to:

- Characterize quantitative storage solutions
- Be able prepare solutions from given quantitative composition
- Analyze principles titrimetric methods research.
  - Analyze quantitative contents in solution acids and basics by help methodsacid-base titration.
  - Do conclusions of acidity biological liquids on based on hydrogenindicator
  - Explain mechanism actions buffer systems and their role in support acid-base balance in biosystems.
  - Analyze relationship between colligative properties and concentrationsolutions
- Interpret chemical and biochemical processes with positions their thermal effects
  - Be able use thermodynamic functions for evaluations orientation processes,explain energy

- coupling in living systems
- Analyze dependence speed reactions from concentration and temperature
  - Interpret dependence speed reactions from energy activation
    - Analyze features actions catalysts and explain mechanism homogeneous and heterogeneous catalysis
      - Explain the mechanism of action of enzymes and analyze the speed dependence enzymatic processes from concentration enzyme and substrate
        - Analyze chemical balance and explain her the condition with positions thermodynamics and kinetics
  - Explain influence external factors on chemical balance
    - Analyze conditions falling out and dissolution sediments, explain role heterogeneous balance by with the participation of salts in general homeostasis body
  - Explain mechanism formation electrode potentials.
    - Analyze principles method potentiometry and do conclusions of him using in medical and biological research.
      - Be able to measure redox potentials and to predict direction oxidativerestorative reactions
  - Do conclusions of superficial activity substances on based on their structures
    - Analyze the features of the structure of the surface layer of adsorbed molecules surfactants compounds, explain principles of biological structure membranes
      - Analyze adsorption equations and limits of their use, distinguish monomolecular and polymolecular adsorption.
  - Interpret regularities adsorption substances with solutions on firm surface
  - Explain physical and chemical foundations methods adsorption therapy
  - Distinguish selective and ion exchange adsorption electrolytes
    - Interpret methods chromatographic analysis and their role in medical and biological research
    - Analyze principles methods obtaining and cleaning colloiddally dispersed solutions
  - Explain physical and chemical foundations hemodialysis
    - Interpret physical and chemical properties proteins, what is structural component everyone body tissues.
      - Do conclusions of charge dissolved biopolymers on based on their isoelectric points

## 2. INFORMATIVE AMOUNT EDUCATIONAL DISCIPLINES

On study educational disciplines "Medical chemistry" is assigned 90 hours, 3 loans ECTS

### SUBSTANTIAL SECTION 1 BASIC LAWS CHEMISTRY. BIO-ORGANIC CHEMISTRY

#### **Topic 1. Structure of atoms, periodic law and periodic system of elements. Chemical communication Complex compounds .**

Building atom Periodic law and periodic system elements D.I. Mendeleev. Chemical communication and him experimental characteristics. Electronic structure and electronegativity of s-, p- and d-elements. Complexation reactions . Coordination theory AND. Werner and modern idea about structure complex compounds . Concept about complexing agent (central ion). Nature, coordination numeric, hybridization orbitals of the complexing agent . Concept of ligands. Coordination capacity ( dentity ) ligands. Internal and external spheres of complexes. Geometry of a complex ion. Nature chemical bond in complex compounds. Classification of complex compounds by charge internal spheres and by by nature ligands. Internal complex compounds Polynuclear complexes Iron-, cobalt -, copper- and zinc-containing biocomplex compounds Concept about metalloligand homeostasis Violation homeostasis Complexons and their application in in medicine as antidotes for heavy metal poisoning ( chelation therapy ) and as antioxidants at storage of medicines.

#### **Topic 2. Biogenic s-, p- and d-elements: chemical properties, biological role, application in medicine**

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

body a person macronutrients, trace elements and impurity elements Organogens. Concept about doctrine V.I. Vernadskyi about biosphere and role alive substances (living organisms). The relationship between the content of biogenic elements in the human body and their content in the environment Endemic disease, their communication with features biogeochemical provinces (areas with a natural deficiency or excess of certain chemical elements in the lithosphere). Problems of pollution and cleaning of the biosphere from toxic man-made chemical compounds origin. The relationship between the location of s- and p- elements in the periodic table and their content in the body. Typical chemical properties of s-, p-elements and their compounds (reactions without change degree of oxidation). Application in medicine. Toxic effect of compounds. Qualitative reactions to ions  $\text{CO}_3^{2-}$ ,  $\text{SO}_4^{2-}$ ,  $\text{NO}_2^-$ ,  $\text{S}_2\text{O}_3^{2-}$ . Metals of life. Typical chemical properties of d-elements and their compounds (reactions with a change in the degree of oxidation, complex formation). Biological role of d-elements and their compounds. Application in medicine. Toxic effect of d-elements and their compounds. Qualitative reactions to ions  $\text{MnO}_4^-$ ,  $\text{Fe}^{3+}$ ,  $\text{Cu}^{2+}$ ,  $\text{Ag}^+$ .

### **Topic 3. The main laws of chemical thermodynamics and their application. Bioenergetics**

The subject of chemical thermodynamics. Basic concepts of chemical thermodynamics: thermodynamic system (isolated, closed, open, homogeneous, heterogeneous), parameters state (extensive, intensive), thermodynamic process (reversible, irreversible). alive organisms – open thermodynamic systems. Irreversibility processes life activities

First law thermodynamics. Enthalpy. Thermochemical equation. Standard enthalpy of formation and burning. Law Hess. Method calorimetry. Energetic characteristic biochemical processes. Thermochemical calculations for evaluations calorie content products nutrition and preparation of rational and therapeutic diets. Arbitrary and non-arbitrary processes. The second law of thermodynamics. Entropy. Thermodynamic potentials: Gibbs energy, energy Helmholtz. Thermodynamic conditions balance Criteria orientation arbitrary processes. Calculation energy Gibbs. Application basic provisions thermodynamics to alive organisms ATP as source energy for biochemical reactions Macroergic compounds Energetic conjugation in alive systems: exergonic and endergonic processes in the body.

### **Topic 4. Chemical kinetics as a basis for studying biochemical rates and mechanisms reactions Catalysis. Chemical balance.**

Reaction speed. Dependence of the reaction rate on the concentration. The law of active masses for speed reactions Constant speed Order reactions Kinetic equation reactions of the first, the second and zero of order Period semi-transformation - quantitative characteristics of changes in the concentration of radionuclides, pesticides, etc. in the environment. The concept of reaction mechanism. Molecularity of the reaction. Calculation of the rate of a chemical reaction. Dependence speed reactions from temperature Rule Van't Hoff. Features temperature reaction rate coefficient for biochemical processes. Activation energy. Active theory accomplices Equation Arrhenius. Concept about theory transitional state (activated complex). Idea about kinetics complex reactions: parallel, consecutive, conjugated, negotiable, competing, chain Concept about antioxidants. Free radical reactions in the living organism. Photochemical reactions, photosynthesis. Catalysis and catalysts Peculiarities of the action of catalysts. Homogeneous, heterogeneous and microheterogeneous catalysis. Acid-base catalysis. Autocatalysis Mechanism of action of catalysts. Promoters and catalytic poisons. Insights into the kinetics of enzymatic reactions. Enzymes as biological catalysts Features actions enzymes: selectivity, efficiency, dependence enzymatic actions from temperature and reactions environment Concept about mechanism actions enzymes Dependence of the rate of enzymatic processes on the concentration of the enzyme and substrate Activation and inhibition of enzymes. Influence of environmental factors on kinetics enzymatic reactions Chemical balance. Constant chemical balance and methods her expression Displacement of chemical equilibrium with changes in temperature, pressure, concentration of substances. Le's principle Chatelier. Calculation of the equilibrium constant and determination of the displacement direction balance

## **SUBSTANTIAL SECTION 2 SOLUTIONS AND THEIR ROLE IN BIOCHEMICAL PROCESSES**

**Topic 5. Solutions, their composition and types. The importance of aqueous solutions in biology and medicine** Classification solutions Mechanism processes dissolution. Thermodynamic approach to process

dissolution. Solubility substances Solubility gases in liquids Dependence solubility gases from pressure (law Henry Dalton ), nature gas and solvent, temperature Influence electrolytes on solubility gases (law Sechenov). Solubility gases in of blood Caisson disease. Solubility liquids and solid substances in liquids Dependence solubility from temperature, nature dissolved substances and solvent Distribution substances between by two liquids, what not are mixed Law distribution Nernst and him value in phenomena permeability biological membranes. Quantities characterizing the quantitative composition of solutions. Preparation solutions from given quantitative composition Calculation quantitative content dissolved substances in solution.

#### **Topic 6. Colligative properties diluted solutions**

Colligative properties divorced solutions non-electrolytes relative decrease pressure saturated couples solvent over solution Law Raul . Ideal solutions Decrease temperature freezing and increase temperature boiling solutions in comparable with solvents. Osmosis and osmotic pressure. Law Van't Hoff . Colligative properties dilute solutions of electrolytes. Isotonic coefficient. Hypo -, hyper - and isotonic solutions. Cryometry , ebulliometry , osmometry , their application in medical and biological research. Role osmosis in biological systems Osmotic pressure plasma of blood Equation Hallera .Oncotic pressure. Plasmolysis and hemolysis

#### **Topic 7. Equilibria in electrolyte solutions. pH of biological fluids. Buffer systems, them biological role**

Solutions electrolytes Electrolytes in body a person Degree and constant dissociation weak electrolytes. Properties of solutions of strong electrolytes. Activity and coefficient activity Iona power solution Water-electrolyte balance - necessary condition homeostasis

Dissociation of water. Ionic product of water. Hydrogen pH indicator . pH values for different liquids human body in norms and pathologies. Theories acids and basics Types protolithic reactions: reactions neutralization, hydrolysis and ionization Hydrolysis of salt Degree hydrolysis, dependence him from concentration and temperature Constant hydrolysis Role hydrolysis in biochemical processes. Calculation pH solutions electrolytes buffers solutions, their classification. Henderson-Hasselbach equation . Mechanism of buffer action. Buffer capacity. Blood buffer systems. Bicarbonate buffer, phosphate buffer. Protein buffer systems. Concept about acid-base blood condition Calculation pH of buffer systems.

#### **Topic 8. Foundations titrimetric analysis**

Foundations titrimetric analysis Methods titrimetric analysis Method acidic the main titration. Acid-base indicators. Reactions sedimentation and dissolution. Solubility product. Precipitation and dissolution conditions. The role of heterogeneous equilibrium for participation of salt in general homeostasis body Calculations by profit solubility

### **SUBSTANTIAL SECTION 3**

#### **PHYSICAL AND CHEMISTRY OF SURFACE PHENOMENA. LYOPHOBIC AND LYOPHILIC DISPERSE SYSTEMS**

#### **Topic 9. Electrode processes and their value for physiology and of medicine**

The role of electrochemical phenomena in biological processes. Electrode potentials and their mechanism occurrence Equation Nernst . Normal (standard) electrode potential. Normal hydrogen electrode. Measurement electrode potentials. Electrodes definition and electrodes comparison. Silver chloride electrode. Ion selective electrodes Glass electrode. Galvanic elements Calculation electrode and redox potentials. Diffusion potential. Membrane potential. The biological role of diffusion and membrane potentials. Potential damage. Potential calmness Potential actions Role oxidative regenerative reactions in life processes. Redox potential as a measure of oxidation and regenerative capacity of systems. Peters equation . Normal redox potential. Prognostication direction redox reactions by values redox potentials. Oxidant and reducing agent equivalent. The value of redox potentials in mechanisms of biological oxidation processes. Potentiometry. Potentiometric determination pH , activity ions Potentiometric titration.

#### **Topic 10 Physico-chemistry superficial phenomenon and their practical value in of biology and medicine**



Superficial phenomena and their value in of biology and medicine Superficial tension liquids and solutions Isotherm superficial tension Surface-active and surface inactive substances Surface activity. Duclos-Traube rule . Adsorption at the liquid-liquid interface gas and liquid-liquid. Gibbs equation. Orientation of molecules of surface-active substances in surface layer. Concept of the structure of biological membranes. Adsorption at the separation boundary solid-gas. Langmuir equation . Adsorption from a solution on the surface of a solid body. physical and chemical adsorption. Laws of adsorption of dissolved substances, vapors and gases. Equation Freundlich . Physico-chemical foundations adsorption therapy (hemisorption, plasma sorption , lymphosorption , enterosorption, application therapy). Immunosorbents . Adsorption of electrolytes: specific (selective) and ion exchange. Panet-Fayance rule . Natural and synthetic ion exchangers . Role adsorption and ionic exchange in processes life activities plants and organisms Chromatography. Classification chromatographic methods analysis by a sign aggregate state of phases, performance technique and distribution mechanism. Adsorption, ion exchange and distributive chromatography Application of chromatography in biology and medicine

**Topic 11. Colloidal solutions: preparation, purification and properties. Coagulation of colloids solutions**

Organism as difficult totality dispersed systems Classification dispersed systems by degree dispersion Colloidal state. Lyophilic and lyophobic colloidal systems. Building colloidal particles Double electric layer. Electrokinetic potential colloidal particles Micelle structure. Coagulation threshold. Methods of obtaining and purifying colloidal solutions. Dialysis, electro dialysis, ultrafiltration, countervailing dialysis, vivodialysis \_ Hemodialysis and the "artificial kidney" device. Molecular-kinetic properties of colloidal systems. Brownivskyi movement, diffusion, osmotic pressure. Optical properties colloidal systems Electrokinetic phenomena Electrophoresis. The Helmholtz-Smolukhovsky equation . Application of electrophoresis in research and clinical and laboratory practice Electrophoregrams . Kinetic (sedimentation) and aggregative stability of dispersed systems. Stability factors. Coagulation. Mechanism of coagulating effect of electrolytes. Coagulation threshold. The Schultze -Hardy rule . Mutual coagulation. Coagulation processes in drinking water and wastewater treatment. Colloidal protection. Dispersive systems with gaseous dispersive environment Classification aerosols , methods obtaining and properties Application aerosols in clinical and sanitaryhygienic practice. Toxic effect of some aerosols . Powders Coarsely dispersed systems with liquid dispersion medium. Suspensions, production methods and properties. Paste, them medical application. emulsions, methods obtaining and properties Types emulsions Emulsifiers. Application of emulsions in clinical practice. Biological role of emulsification. Semi-colloidal soap, detergents. Micelle formation in solutions semicolloids.

**Topic 12. Properties solutions biopolymers**

High molecular compounds are the basis of living organisms. Globular and fibrillar structure proteins Comparative characteristic solutions high molecular weight compounds , true ones and colloidal solutions. Swelling and dissolution of polymers. Swelling mechanism. Effect of pH environment, temperature and electrolytes on the swelling rate. Thixotropy. Syneresis. Salting out biopolymers with solutions Coacervation and her role in biological systems Anomalous viscosity solutions Navy Viscosity of blood Membrane balance Donnan . Isoelectric state squirrel. Isoelectric point and methods her definition. Ionic state biopolymers in aqueous solutions.

**3. STRUCTURE EDUCATIONAL DISCIPLINES**

Name content sections and topics	Number hours			
	That's all	IN ago number of		
		l	p	s.r. _
<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>	<b>5</b>
<b>Contentful section 1</b>				
Topic 1. Building atoms, periodic law and periodic system elements. Chemical communication Complex compounds	8	2	2	4

Topic 2. Biogenic s-, p- and d- elements: chemical properties, biological role, application in medicine	8		4	4
Topic 3. The main ones laws chemical thermodynamics and their application. Bioenergetics.	8	2	2	4
Topic 4. Chemical kinetics as basis speed study and mechanism biochemical reactions Catalysis. Chemical balance.	10	2	4	4
<b>Contentful section 2.</b>				
Topic 5. solutions, their storage and types Value water solutions in of biology and medicine	8	2	2	4
Topic 6. Colligative properties diluted solutions	4		2	2
Topic 7. Equilibrium in solutions electrolytes pH biological liquids buffers systems, their biological role	10	2	4	4
Topic 8 Foundations titrimetric analysis	4		2	2
<b>Contentful section 3.</b>				
Topic 9. Electrode processes and their value for physiology and of medicine	6	2	2	2
Topic 10. Physico-chemistry of surface phenomena and their practical significance in biology and medicine	6		2	4
Topic 11. Colloidal solutions: obtaining, cleaning and properties Coagulation colloidal solutions	8	2	2	4
Topic 12. Properties solutions biopolymers.	8	2	2	4
Final CONTROL assimilation course "Medical chemistry"	2		2	
<i>That's all hours</i>	<b>90</b>	<b>16</b>	<b>32</b>	<b>42</b>

#### 4. THEMES LECTURES

No	Name topics	Number hours
1	Periodicity properties chemical elements and their compounds . Chemistry biogenic elements. Application complex compounds in medicine	2
2	The main ones concept and laws chemical thermodynamics. Bioenergetics	2
3	Kinetics biochemical reactions Features enzymatic catalysis Chemical balance and constants balance	2
4	Solutions and their role in I will run biochemical processes. Colligative properties diluted solutions	2
5	Theory acids and basics pH biological liquids buffers systems, their biological role	2
6	Role superficial phenomenon in processes, what are happening in body	2
7	physical chemistry dispersed systems	2
8	Biological macromolecules: structure, solutions biopolymers, properties	2
<b>TOGETHER:</b>		<b>16</b>

#### 5. Seminary occupation

Working program not provided for

#### 6. Topics practical classes

No	Topic	Number hours
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<b>1</b>	<b>2</b>	<b>3</b>
1	Introduction to course medical chemistry Quantum mechanical model atom Finding in periodic system and structure atoms bioelements . Chemical contact: types and experimental characteristics.	2
2	Bioelements , their classification and content of organisms. Micro- and macroelements . Biogenic s- and p-elements: chemical properties, biological role, application in medicine.	2
3	Biogenic d-elements: chemical properties, biological role. Application complex compounds of d-elements in medicine.	2
4	First and second laws thermodynamics. Heat effect chemical reactions Orientation of processes in closed systems .	2
5	hurry up reactions, molecularity and order. Dependence speed reactions from concentration responders substances, temperature, pressure	2
	Catalysis. Features enzymatic catalysis	
6	Chemical equilibrium. Constant equilibrium: thermodynamic and concentration	2
7	general data about solutions, types storage. Methods expression quantitative composition of solutions. Solubility of the substance	2
8	Colligative properties diluted solutions	2
9	Electrolyte solutions . Dissociation of water. Equilibrium of solutions electrolytes Theory acids and basics Hydrolysis of salt	2
10	pH biological liquids buffer systems, their biological role	2
11	Foundations titrimetric analysis	2
12	Product solubility Definition redox potential	2
13	Sorption biologically active substances Ionic exchange. Chromatography	2
14	Obtaining, cleaning and properties colloidal solutions Coagulation colloidal solutions	2
15	High molecular weight compounds - basis alive organisms	2
16	TEST	2
<b>TOGETHER:</b>		<b>32</b>

## 7. THEMES LABORATORY JOIN

Working program not provided for

## 8. INDEPENDENT WORK

<b>No</b>	<b>Topic</b>	<b>Number hours</b>
<b>1</b>	<b>2</b>	<b>3</b>
1	Building electronic shell atoms Periodic law D.I. Mendeleev. The structure of the periodic table elements. covalent, ionic , metallic and hydrogen communication	2
2	A. Werner's coordination theory. The concept of a complexing agent (central ion), coordination numeric, coordination capacity ( dentity ) ligands. Classification complex compounds	2
3	Teachings of V.I. Vernadsky about the biosphere. Relationship between content biogenic elements in the human body and their content in the environment. Biogenic elements AND and II groups periodic systems elements D.I. Mendeleev	2
4	Biogenic p- and d-elements. Toxic action d-elements and their compounds .	2

	Quality reactions on ions $\text{CO}_3^{2-}$ , $\text{SO}_4^{2-}$ , $\text{NO}_2^-$ , $\text{S}_2\text{O}_3^{2-}$ , $\text{MnO}_4^-$ , $\text{Fe}^{3+}$ , $\text{Cu}^{2+}$ , $\text{Ag}^+$ .	
5	Concept of chemical thermodynamics: thermodynamic system, parameters state thermodynamic process. Law Hess . Method calorimetry.	2
6	Entropy. Orientation processes in closed systems	2
7	Energy activation Theory active accomplices Equation Arrhenius .	2
8	Bias balance Principle Le Chatelier	2
9	Solubility gases / solid substances in liquids Methods expression concentration solutions	2
10	Isotonic coefficient. Hypo -, hyper - and isotonic solutions	2
11	Calculation pH solutions electrolytes Definition buffer containers	2
<b>1</b>	<b>2</b>	<b>3</b>
12	Titrimetric analysis. Acid-base titration.	2
13	Titrimetric analysis. Methods oximetry.	2
14	Methods sedimentation. Definition content halides method Mora	2
15	The Nernst equation . Silver chloride electrode. Ion selective electrodes Glass electrode	2
16	Definition pH solutions potentiometric method	2
17	Definition impact surface-active substances on value superficial tension	2
18	Chromatography. Classification chromatographic methods analysis	2
19	Coagulation colloidal solutions Colloidal protection	2
20	Electrophoresis. Electroosmosis.	2
21	Swelling and dissolution polymers	2
<b>TOGETHER:</b>		<b>42</b>

## 9. INDIVIDUAL TASKS ARE NOT PROVIDED

## 10. TEACHING METHODS

According to the sources of knowledge, teaching methods are used: verbal - story, explanation, lecture, instruction; visual - demonstration, illustration; practical - practical work, problem solving. According to the nature of the logic of knowledge, methods are used: analytical, synthetic, analytical-synthetic, inductive, deductive. According to the level of independent mental activity, the following methods are used: problem-based, searching, research.

1. Verbal methods: lecture, conversation;
2. Visual methods: illustration, demonstration
3. Practical methods: performing practical work and solving situational tasks to develop skills and abilities;
4. Students' independent work on understanding and assimilation of new material
5. Use of control and educational computer programs
6. Innovative teaching methods: business game, case method.

The types of training according to the curriculum are: lectures; practical training; independent work of students.

## 11. CONTROL METHODS

**Current control** is carried out on the basis of control theoretical knowledge, practical skills

and abilities.

**Forms of current control** are: *in* the dream survey (frontal, individual, combined), interview; practical verification of professional skills (conducted based on the results of practical work at the end of the class); test control ("open" and "closed" test tasks).

Current control is mandatory. During the evaluation of mastering of each topic from all disciplines of the curriculum for the current educational activity, the student is given grades on a 4-point (traditional scale) taking into account the approved evaluation criteria for the discipline. All types of work provided by the curriculum are taken into account. The student must receive a grade in each topic. The teacher conducts a survey of each student in the group at each lesson and assigns a grade in the journal of attendance and student success according to the traditional scale ("5", "4", "3", "2").

When evaluating the student's current educational activity, 20% of the grade is the student's independent work, which takes into account the knowledge of the topic of independent study and the performance of work in the notebook.

The final (summary) control of the sections is carried out at the end of the section in the form of a written test, which includes test tasks from the "Step-1" bank, theoretical questions and control of practical skills (solving situational problems, defining and describing macro- and micropreparations, etc.).

Such methods of control as oral, written and test are used, which should contribute to increasing the motivation of students-future specialists for educational and cognitive activities. According to the specifics of professional training, preference is given to test and written control. In the case of final control, preference is given to written or test control.

## 12. FORM CONCLUSION CONTROL GOOD LUCK TEACHING

Final CONTROL of knowledge with disciplines is carried out in form differentiated offset in 1st \_ semester teaching after study everyone topics planned given program Differentiated test with disciplines is conducted in the form of a written test for individual options, each of which contains 3 test tasks.

## 13. CALCULATION SCHEME AND DISTRIBUTION OF POINTS AWARDEDSTUDENTS

Only those students who do not have academic debt (all missed classes have been completed) and whose average score for the current educational activity in the academic discipline is at least "3" are admitted to the differential.

*The maximum number of points* that a student can score for the current educational activity for admission to the exam is 120 points and is defined as the sum of the arithmetic average of all grades received in the semester.

*The minimum number of points* that a student must score for the current educational activity for admission to the exam is 72 points. Recalculation of the average grade for the current academic performance (on a 120-point scale) in the table. 3.

**Table 3.**

**Recalculation of the average grade for current success in a multi-point scale for disciplines ending with a diploma**

4-point scale	200-point scale	4-point scale	200-point scale	4-point scale	200-point scale
5	120	4.29	103	3.58	86
4.96	119	4.25	102	3.54	85
4.92	118	4.21	101	3.50	84
4.87	117	4.17	100	3.46	83
4.83	116	4.12	99	3.42	82

4.79	115	4.08	98	3.37	81
4.75	114	4.04	97	3.33	80
4.71	113	4.00	96	3.29	79
4.67	112	3.96	95	3.25	78
4.62	111	3.92	94	3.21	77
4.58	110	3.87	93	3.17	76
4.54	109	3.83	92	3.12	75
4.50	108	3.79	91	3.08	74
4.46	107	3.75	90	3.04	73
4.42	106	3.71	89	3	72
4.37	105	3.67	88	Less than 3	Not enough
4.33	104	3.62	87		

The maximum number of points that a student can score when taking the Difzalik is 80 (the minimum number is at least 50).

Discipline assessment is defined comprehensively as the sum of points for the current educational activity and points for the exam.

From the allocated 120 points for the current educational activity, 4 to 12 additional points are allocated for the assessment of individual independent work of higher education applicants, according to the work curriculum. Encouragement points are added to the final grade for the discipline at the end of its study.

Points with disciplines for students, which successfully completed the program are converted into the national scale and ECTS system (Table 4, 5).

Table 4.

Discipline points	Evaluation on a 4-point scale
From 180 to 200 points	5
From 150 to 179 points	4
From 149 points to the minimum number of points that the student must score	3
Below the minimum number of points that the student must score	2

Table 5

**Scale assessment: national and ECTS**

Total points for all types teaching activities	Rating ECTS	Rating by national scale	
		for exam, difzalik	for offset
180-200	A ND	perfectly	counted
160-179	I N	fine	
150-159	W ITH		
130-149	D	satisfactorily	
120-129	E		

50-119	F X	unsatisfactorily with the possibility of refolding	not counted with possibility rearrangement
0-49	F	unsatisfactorily with mandatory repeated studying the discipline	not counted with mandatory repeated study disciplines

## 14. METHODOICAL SECURITY

1. working educational program disciplines;
2. Plans lectures, practical classes and independent work students;
3. Theses lectures with disciplines;
4. Methodical recommendations and developments teacher;
5. Methodical instructions to practical classes for students;
6. Methodical materials, what provide independent work students;
7. Test and control task to practical classes;

## 15. RECOMMENDED LITERATURE

### The main one literature

1. Medical chemistry: textbook / V.O. Kalibabchuk , I.S. Chekman , V.I. Galinska and others; by ed.V.O. Kalibabchuk . — the 4th kind. - K. : VSV "Medicine", 2019. - 336 p.
2. Medical chemistry: textbook / V.P. Muzychenko, D.D. Lutsevich , L.P. Yavorska; by ed. B.S.Zimenkovsky . – 3rd ed., ed . - K.: VSV "Medicine", 2018. - 496 p.
3. Medical chemistry : textbook / Frost A.S., D.D. Lutsevich , L.P. Yavorska - Vinnitsa : Novabook, 2008. -776 p.
4. Medical chemistry: textbook / Homonai V.I., WITH. Milovych , - Vinnitsa : Nova book, 2016 . –672 p.

### Auxiliary literature

1. Myronovich L.M. Medical chemistry: Educational manual. – Kyiv: Caravel, 2008. – 159 p.
2. Poretsky A.V., Bannikova-Bezrodna O.V., Philippova L.V. Medical chemistry: Textbook. – K.: VSV "Medicine", 2012. - 384 p.

## 16. INFORMATIONAL RESOURCE

1. State formulary of medicinal products. Issue 1, Issue 2, Issue 3, Issue 4, Issue 5, issue 6, issue 7, issue 8, issue 9, issue 10, issue 11 / edited by V.T. Chumaka, V.I. Maltseva, A.M. Morozova, V.D. Paria, A.V. Stepanenko. - K.: Morion .
2. International Statistics Classification of Diseases and Related Health Problems , 10th Revision , Version for 2007 [Electronic resource]. – Regime access: <http://apps.who.int/classifications/apps/icd/icd10online/>
3. Rational use of medicines : progress in implementing the WHO medicines strategy Report by the Secretariat , EB118/6, 11 May 2006, [Electronic resource]. – Regime access: [www.who.int/gb/ebwha/pdf\\_files/EB118/B118\\_6-en.pdf](http://www.who.int/gb/ebwha/pdf_files/EB118/B118_6-en.pdf)
4. <http://guides.lib.vt.edu/oer/chemistry> - books on chemistry
5. [www.ncbi.nlm.nih.gov/PubMed](http://www.ncbi.nlm.nih.gov/PubMed) – free access to base scientific data
6. <https://pubchem.ncbi.nlm.nih.gov/> - free access to base scientific data
7. [www.pereplet.ru/cgi/soros/readdb.cgi](http://www.pereplet.ru/cgi/soros/readdb.cgi) – Sorosovsky educational magazine – free access to popular science articles on chemistry and biochemistry.

8. <https://pubs.acs.org/journal/jmcmar> - Journal of Medicinal Chemistry