


**SYLLABUS OF THE ACADEMIC DISCIPLINE «Biological role of life elements»**
**1. General Information**

<b>Faculty</b>	Faculty of Foreign Students
<b>Programme</b>	22 Healthcare, 221 Dentistry, 2 <sup>nd</sup> Master's degree of Higher education, full-time
<b>Academic year</b>	2023-2024
<b>Subject</b>	Biological role of life elements, ББ 1.7, <a href="https://new.meduniv.lviv.ua/osvitni-programy/">https://new.meduniv.lviv.ua/osvitni-programy/</a>
<b>Department</b>	Department of General, Bioinorganic, Physical and Colloidal Chemistry, 52 Pekarska str., Lviv, 79010 Telephone: +38 (032) 2754987, Shymzeriv str. 3a, Lviv, 79010 Telephone: +38 (032) 2786431, e-mail: <a href="mailto:kaf_genchemistry@meduniv.lviv.ua">kaf_genchemistry@meduniv.lviv.ua</a>
<b>Head of the Department</b>	Iryna V. Drapak, DSc, PhD, Professor, e-mail: <a href="mailto:drapak_iryana@meduniv.lviv.ua">drapak_iryana@meduniv.lviv.ua</a>
<b>Year</b>	1 <sup>st</sup> year
<b>Semester</b>	I
<b>Type of the Subject</b>	obligatory
<b>Professors</b>	Olena Klenina, PhD in Pharmacy, Assoc. Professor, e-mail: <a href="mailto:olena_klenina@yahoo.com">olena_klenina@yahoo.com</a> Oleksandra Roman, PhD in Pharmacy, Assoc. Professor, e-mail: <a href="mailto:lesia_roman@ukr.net">lesia_roman@ukr.net</a> Marta Sulyma, PhD in Pharmacy, Assist. Professor, e-mail: <a href="mailto:sumarta145@gmail.com">sumarta145@gmail.com</a> Iryna Myrko, Assist. Professor, e-mail: <a href="mailto:irynaoliinyk@gmail.com">irynaoliinyk@gmail.com</a>
<b>Erasmus</b>	No
<b>Responsible for Syllabus</b>	Marta Sulyma, PhD in Pharmacy, Assist. Professor, e-mail: <a href="mailto:sumarta145@gmail.com">sumarta145@gmail.com</a>
<b>Credits ECTS</b>	3,5
<b>Hours</b>	105 Hours (Lectures – 10 hours, Practical classes – 30 hours, Individual work – 65 hours)
<b>Language of instruction</b>	English
<b>Consultations</b>	Consultations take place according to the approved schedule, both offline (face-to-face) and online, using ICT available to students and

	teachers
Address, telephone and regulations of the clinical base, office	-
<b>2. Course overview</b>	
<p>The elective course "The Biological Role of the Elements of Life" is an organic complement and deepening of the study of one of the fundamental natural disciplines in the system of higher medical education, knowledge of which is necessary for fruitful, creative work of health professionals. The knowledge acquired during the study of the elective course is necessary for the fruitful, creative work of specialists in the field of dentistry. The elective course develops a dialectical way of thinking, expands and deepens scientific knowledge about the matter, structure and properties of chemical elements and their transformations, as well as identifies ways to solve applied problems in the field of health care.</p> <p>Knowledge from the elective course "Biological role of life elements" will allow future specialists to master the most essential skills of qualitative and quantitative forecasting of the probability of biochemical processes and physico-chemical basis of interpretation of different types of balance of biological systems.</p>	
<b>3. Course objectives</b>	
<p><b>1. The goal of the elective course "Biological role of elements of life" studying</b> is the formation of students' scientific worldview, development of modern forms of theoretical thinking and ability to analyze phenomena, skills and abilities to apply chemical and physicochemical laws and processes in other disciplines. and in future practical activities.</p> <p><b>2. Course objectives</b> are to teach students to use basic concepts of chemistry, basic laws of chemistry, general laws of chemical reactions, the doctrine of solutions, general information about chemical elements and their compounds, knowledge of physicochemical bases different types of balance of biological systems in solving specific problems in the field of medicine in accordance with modern needs.</p> <p><b>3. General Competences:</b></p> <ol style="list-style-type: none"> <li>1. the ability to abstract thinking, analysis and synthesis;</li> <li>2. knowledge and understanding of the subject area and understanding of professional activity;</li> <li>3. the ability to apply knowledge in practical situations;</li> <li>4. the skills of information and communication technologies application;</li> <li>5. the ability to search, process and analyze information from various sources.</li> <li>6. ability to adapt and act in a new situation; ability to work independently;</li> <li>7. The ability to identify, set and solve problems;</li> <li>8. the ability to assess and ensure the quality of work.</li> <li>9.</li> </ol> <p><b>Special (professional) competencies:</b></p> <ol style="list-style-type: none"> <li>1. the ability to determine the required list of laboratory and instrumental studies and evaluate their results;</li> <li>2. the ability to determine the nature of nutrition in the treatment of diseases;</li> <li>3. to define tactics of emergency medical care provision on the basis of the urgent state diagnosis;</li> <li>4. the ability to determine the principles and nature of the treatment of diseases;</li> <li>5. the ability to assess the impact of the environment, socio-economic and biological determinants on the health of the individual, family, population.</li> </ol>	

#### 4. Prerequisites of the Course

The elective course "Biological role of life elements":

Based on previously studied by students subjects in secondary school such as Chemistry, Elementary Mathematics and Physics. Knowledge of the theoretical material of medical chemistry is necessary for the further assimilation of knowledge physiology, pathophysiology, biological chemistry, general and molecular pharmacology and toxicology, hygienic disciplines and ecology.

#### 5. Results of the Course

##### Results

Code of the learning outcomes	The content of the learning outcomes	Matrix of competencies
ЗН – knowledges УМ – skills АВ – independence and responsibility К – competence		ПП – program learning outcomes
<i>3H-1</i>	to know the qualitative reactions to ions of potentially toxic elements	<i>ПП- 3</i>
<i>3H-2</i>	to know qualitative reactions to ions of nonmetals microelements	ПП-2, ПП-4, ПП-12, ПП-18
<i>3H-3</i>	to know qualitative reactions to ions of metals microelements	ПП-2, ПП-4, ПП-12, ПП-18
<i>3H-4</i>	to know qualitative reactions to ions of nonmetals macroelements	ПП-2, ПП-4, ПП-12, ПП-18
<i>3H-5</i>	to know qualitative reactions to ions of metals macroelements	ПП-2, ПП-4, ПП-12, ПП-18
<i>3H-6</i>	to know the chemical composition of cells, blood and plasma	ПП-2, ПП-4, ПП-12, ПП-18
<i>3H-7</i>	to know the concept of "human microelementosis"	ПП-2, ПП-4, ПП-12, ПП-18
<i>3H-8</i>	to know the concepts of "metal-ligand homeostasis", "metal-ligand pathologies", "bioligand", "chelation therapy"	ПП-2, ПП-4, ПП-12, ПП-18
<i>3H-9</i>	to know the chemical composition of cells, blood and plasma	ПП-2, ПП-4, ПП-12, ПП-18
<i>3H-10</i>	to know the concept of "human microelementosis"	ПП-2, ПП-4, ПП-12, ПП-18
<i>3H-11</i>	to know the concepts of "metal-ligand homeostasis", "metal-ligand pathologies", "bioligand", "chelation therapy"	ПП-2, ПП-4, ПП-12, ПП-18
<i>3H-12</i>	to know the mechanism of action of complexones as drugs	ПП-2, ПП-4, ПП-12, ПП-18, ПП-32
<i>3H-13</i>	to know the methods of assessing the elemental status of human	ПП-2, ПП-4, ПП-12, ПП-18
<i>3H-14</i>	to know the methods of using metals as probes in biochemical research	ПП-2, ПП-4, ПП-12, ПП-18
<i>3H-15</i>	to know the medicines of metals, metalloids and non-metals	ПП-2, ПП-4, ПП-12, ПП-18, ПП-32
<i>3H-16</i>	to know the classification of chemical elements	ПП-2, ПП-4, ПП-12, ПП-18
<i>3H-17</i>	to know the importance of acid-base homeostasis for the human body	ПП-2, ПП-4, ПП-12, ПП-18
<i>3H-18</i>	to know the teachings of V. Vernadsky on the biosphere	ПП-2, ПП-4, ПП-12, ПП-18
<i>3H-19</i>	to know the biological significance, toxic effects, content in the body, application in medicine of potentially toxic elements	ПП-2, ПП-4, ПП-12, ПП-18

3H-20	to know the biological significance, toxic effects, content in the body, application in medicine of toxic elements	ПР-2, ПР-4, ПР-12, ПР-18
3H-21	to know the biological significance, content in the body, application in medicine for Oxygen	ПР-2, ПР-4, ПР-12, ПР-18
3H-22	to know the biological significance, content in the body, application in medicine of Hydrogen	ПР-2, ПР-4, ПР-12, ПР-18
3H-23	to know the biological significance, content in the body, application in medicine of Nitrogen	ПР-2, ПР-4, ПР-12, ПР-18
3H-24	to know the biological significance, content in the body, application in medicine of Phosphorus	ПР-2, ПР-4, ПР-12, ПР-18
3H-25	to know the biological significance, content in the body, application in medicine of Sulfur	ПР-2, ПР-4, ПР-12, ПР-18
3H-26	to know the biological significance, content in the body, application in medicine of Chlorine	ПР-2, ПР-4, ПР-12, ПР-18
3H-27	to know the biological significance, content in the body, application in medicine of Calcium	ПР-2, ПР-4, ПР-12, ПР-18
3H-28	to know the biological significance, content in the body, application in medicine of Potassium	ПР-2, ПР-4, ПР-12, ПР-18
3H-29	to know the biological significance, content in the body, application in medicine of Sodium	ПР-2, ПР-4, ПР-12, ПР-18
3H-30	to know the biological significance, content in the body, application in medicine of Magnesium	ПР-2, ПР-4, ПР-12, ПР-18
3H-31	to know the biological significance, content in the body, application in medicine of Iron	ПР-2, ПР-4, ПР-12, ПР-18
3H-32	to know the biological significance, content in the body, application in medicine of Zinc	ПР-2, ПР-4, ПР-12, ПР-18
3H-33	to know the biological significance, content in the body, application in medicine of Copper	ПР-2, ПР-4, ПР-12, ПР-18
3H-34	to know the biological significance, content in the body, application in medicine of Manganese	ПР-2, ПР-4, ПР-12, ПР-18
3H-35	to know the biological significance, content in the body, application in medicine of Molybdenum	ПР-2, ПР-4, ПР-12, ПР-18
3H-36	to know the biological significance, content in the body, application in medicine of Cobalt	ПР-2, ПР-4, ПР-12, ПР-18
3H-37	to know the biological significance, content in the body, application in medicine of Chrome	ПР-2, ПР-4, ПР-12, ПР-18
3H-38	to know the biological significance, content in the body, application in medicine of Iodine	ПР-2, ПР-4, ПР-12, ПР-18
3H-39	to know the biological significance, content in the body, application in medicine of Selenium	ПР-2, ПР-4, ПР-12, ПР-18
3H-40	to know the biological significance, content in the body, application in medicine of Fluorine	ПР-2, ПР-4, ПР-12, ПР-18
3H-41	to know the biological significance, content in the body, application in medicine of Boron	ПР-2, ПР-4, ПР-12, ПР-18
3H-42	to know the biological significance, content in the body, application in medicine of Silicon	ПР-2, ПР-4, ПР-12, ПР-18
3H-43	to know the biological significance, content in the body, application in medicine of Bromine	ПР-2, ПР-4, ПР-12, ПР-18
3H-44	to know the biological significance, content in the body, application in medicine of Nicole	ПР-2, ПР-4, ПР-12, ПР-18
3H-45	to know the biological significance, content in the body, application in medicine of Vanadium	ПР-2, ПР-4, ПР-12, ПР-18
3H-46	to know the biological significance, content in the body, application in medicine of Arsenic	ПР-2, ПР-4, ПР-12, ПР-18
3H-47	to know the biological significance, content in the body, application in medicine of Lithium	ПР-2, ПР-4, ПР-12, ПР-18
3H-48	<b>to know the basic measures to prevent infection and spread of COVID-19 caused by SARS-CoV-2 virus, and properly implement them in higher education</b>	ПР-2, ПР-3
УМ-1	to be able to calculate and determine oncotic pressure	ПР-2, ПР-3, ПР-4, ПР-12, ПР-18
УМ-2	to be able to carry out qualitative reactions to ions of conditionally vital microelements	ПР-2, ПР-3, ПР-4, ПР-12, ПР-18
УМ-3	to be able to carry out qualitative reactions to ions of toxic elements	ПР-2, ПР-3, ПР-4, ПР-12, ПР-

		18
<i>Y<sub>M-4</sub></i>	to be able to conduct qualitative reactions to ions of potentially toxic elements	PP-2, PP-3, PP-4, PP-12, PP-18
<i>Y<sub>M-5</sub></i>	to be able to carry out qualitative reactions on ions of microelements of nonmetals	PP-2, PP-3, PP-4, PP-12, PP-18
<i>Y<sub>M-6</sub></i>	to be able to carry out qualitative reactions on ions of microelements of metals	PP-2, PP-3, PP-4, PP-12, PP-18
<i>Y<sub>M-7</sub></i>	to be able to perform qualitative reactions on ions of macroelements of nonmetals	PP-2, PP-3, PP-4, PP-12, PP-18
<i>Y<sub>M-8</sub></i>	to be able to perform qualitative reactions on ions of macroelements of metals	PP-2, PP-3, PP-4, PP-12, PP-18
<i>Y<sub>M-9</sub></i>	to be able to explain the migration of bioelements in nature and the human body	PP-2, PP-3, PP-4, PP-12, PP-18
<i>Y<sub>M-10</sub></i>	to be able to classify chemical elements	PP-2, PP-3, PP-4, PP-12, PP-18
<i>Y<sub>M-11</sub></i>	to be able to suggest possible ways to correct metal-ligand homeostasis	PP-2, PP-3, PP-4, PP-12, PP-18
<i>Y<sub>M-12</sub></i>	to be able to suggest possible ways to correct acid-base homeostasis	PP-2, PP-3, PP-4, PP-12, PP-18
<i>Y<sub>M-12</sub></i>	to be able to suggest possible ways to correct acid-base homeostasis	<i>PP2, PP3, PP4, PP12, PP18</i>
<i>Y<sub>M-13</sub></i>	to be able to experimentally obtain chelated compounds of toxic metals	<i>PP2, PP3, PP4, PP12, PP18</i>
<i>Y<sub>M-14</sub></i>	to be able to experimentally obtain some coordination compounds of metals	<i>PP2, PP3, PP4, PP12, PP18</i>
<i>Y<sub>M-15</sub></i>	to be able to establish a relationship between the properties of bioelements and their position in the periodic table	<i>PP2, PP3, PP4, PP12, PP18</i>
<i>Y<sub>M-16</sub></i>	to be able to determine blood pH	<i>PP2, PP3, PP4, PP12, PP18</i>
<i>K-1</i>	ability to apply knowledge in practical situations	<i>PP2, PP3, PP4, PP12, PP18</i>
<i>K-2</i>	ability to abstract thinking, analysis and synthesis, ability to learn and be modernly trained	<i>PP2, PP3, PP4, PP12, PP18</i>
<i>K-3</i>	knowledge and understanding of the subject area	<i>PP2, PP3, PP4, PP12, PP18</i>
<i>K-4</i>	ability to evaluate and ensure the quality of performed work	<i>PP2, PP3, PP4, PP12, PP18</i>
<i>K-5</i>	ability to organize activities for the preparation of solutions	<i>PP2, PP3, PP4, PP12, PP18</i>
<i>K-6</i>	ability to organize activities for planning and performing simple chemical experiments	<i>PP2, PP3, PP4, PP12, PP18</i>
<i>K-7</i>	the ability to predict the chemical properties of an element and its compounds depending on its position in the periodic table	<i>PP2, PP3, PP4, PP12, PP18</i>
<i>AB-1</i>	to be responsible for making decisions in difficult conditions	<i>PP2, PP3, PP4, PP12, PP18</i>
<i>AB-2</i>	to be responsible for the timely acquisition of modern knowledge	<i>PP2, PP3, PP4, PP12, PP18</i>
<i>AB-3</i>	to be responsible for the quality of work	<i>PP2, PP3, PP4, PP12, PP18</i>
<i>AB-4</i>	independence, responsibility	<i>PP2, PP3, PP4, PP12, PP18</i>

## 6. Course format and content

Course format	Full-time Course	
Classes	Hours	Groups
Lectures	10	-
Practical	30	-
Seminars		-
Individual	65	-

## 7. Topics and content of the Course

Code of the classes type	Topic	Content	Code of the learning outcomes	Professor
Π-1/Π-1/CPC-1	Chemical elements in the geosphere and biosphere. The position of nutrients in the Periodic Table. The concept of human microelementosis	<p>Classifications of chemical elements. Biogenic elements. Macro- and microelements. The position of nutrients in the periodic system of DI Mendeleev. Relationship of physicochemical parameters of elements with their position in the periodic table and content in the body. Properties and biological role of some s-, p- and d-elements.</p> <p>V. Vernadsky's doctrine of the biosphere and biogeochemistry. The concept of migration of chemical elements. Association of endemic diseases with features of biogeochemical provinces. Human and the biosphere. The noosphere. Technological progress and ecology.</p> <p>Human microelementosis as a pathological process caused by deficiency, excess or imbalance of macro- and microelements. Indications for laboratory diagnosis. Biochemical indicators of human elemental status.</p>	<i>3H-1, 3H-10, 3H-13, 3H-16, 3H-18, VM-9, VM-10, VM-15, K-1, K-2, K-3, K-4, K-5, K-6, AB-1, AB-2, AB-3, AB-4</i>	O.Klenina O.Roman M.Sulyma I.Myrko
Π-2/Π-1/CPC-2	The chemical composition of cells and blood, the function of individual elements in them	<p>The chemical composition of the cell. General characteristics of macro- and microelements of the cell. Their biological significance.</p> <p>Inorganic compounds in the cell. Influence of water in the activity of cells of a living organism. The role of mineral salts in the cell.</p> <p>Organic compounds in the cell and their biological significance.</p> <p>Blood and its functions, components of blood. Blood volume (total, circulating (BCC), deposited). Blood viscosity. Relative density of blood (value, size).</p> <p>Plasma, its composition, the role of plasma proteins. Osmotic and oncotic pressures. Functional system that maintains the stability of the osmotic pressure. The concept of physiological isotonic solutions; hypertonic and hypotonic solutions. Hemorrhagic fluids.</p> <p>Acid-base homeostasis, its significance for the body. Physico-chemical</p>	<i>3H-9, 3H-17, VM-1, VM-12, VM-16, K-1, K-2, K-3, K-4, K-5, AB-1, AB-2, AB-3, AB-4</i>	

		mechanisms that maintain acid-base balance in the body. Physiological mechanisms of homeostatic regulatory functions of the kidneys, lungs, liver, gastrointestinal tract and bone tissue. Buffer systems of the internal environment of the organism. Functional system that maintains acid-base homeostasis.		
II-3/II-2/CPC-3	Bioelements organogens (O, C, H, N). Non-metallic macronutrients (P, S, Cl)	<p>Oxygen. General characteristics, distribution in nature, biological role. Chemical bases of oxygen and ozone application in medicine.</p> <p>Carbon, biological significance. Carbon allotropy. Carbon (II) compounds. Carbon monoxide, its acid-base and redox characteristics. Carbon monoxide as a ligand, the chemical basis of its toxicity. Chemical bases of application of Carbon and its compounds in medicine.</p> <p>Hydrogen. General characteristics of the element, biological significance. Features of the situation in the periodic system of elements. Chemical bases of Hydrogen and its compounds application in medicine.</p> <p>Nitrogen. General characteristics, biological significance. Compounds with different values of oxidation states. Chemical bases of Nitrogen and its compounds application in medicine.</p> <p>Phosphorus. General characteristics, biological significance. Allotropic modifications of Phosphorus, their chemical activity. Qualitative reaction to phosphate ion. Chemical bases of application of Nitrogen and its compounds in medicine.</p> <p>Sulfur. General characteristics. Biological role of sulfur (sulfhydryl groups and disulfide bridges in proteins). Sulphides of metals and nonmetals, their solubility in water and hydrolysis. Qualitative reactions on sulfur-containing ions. Chemical bases of Sulfur and its compounds application in medicine.</p> <p>General characteristics of Chlorine as a representative of halogens. Chlorine compounds with metals and nonmetals. Biological role of chlorine compounds. The application of chlorinated lime, chlorinated water, active chlorine preparations in medicine, sanitation.</p>	<i>3H-7, 3H-8, 3H-16, 3H-21, 3H-22, 3H-23, 3H-24, 3H-25, 3H-26, VM-7, K-1, K-2, K-3, K-4, K-5, AB-1, AB-2, AB-3, AB-4</i>	
II-4/II-2/CPC-4	Macroelements metals (Ca, K, Na, Mg)	<p>General characteristics of s-elements of IA and IIA groups. Distribution in nature. Chemical properties of s-elements. General information about nutrients. Qualitative and quantitative content of nutrients in the human body. Biological role of elements in the mineral balance of the organism. Macroelements, their content in the body. Ionophores and their role in membrane transport of potassium and sodium ions. Characteristics of the ionic state of these elements. The use of</p>	<i>3H-8, 3H-16, 3H-27, 3H-28, 3H-29, 3H-30, VM-8, K-1, K-2, K-3, K-4, K-5, AB-1, AB-2, AB-3, AB-4</i>	

		sodium and potassium compounds in medicine. Biological role of Calcium and Magnesium. Chemical bases of application of compounds of Magnesium, Calcium in medicine.		
II-5/II-3/CPC-5	Microelements metals (Fe, Zn, Cu, Mn, Mo, Co, Cr)	<p>General characteristics of iron, zinc, copper, manganese, molybdenum, chromium and cobalt, ionic states, coordination numbers, chemical activity of their simple substances, natural compounds.</p> <p>Acid-base and redox characteristics of compounds of Iron, Zinc, Copper, Manganese, Molybdenum, Chromium and Cobalt. Salts of these biometals, their solubility and hydrolysis, thermal decomposition of nitrates. Complex compounds Zn, Fe, Cu, Co, Cr, Mn, Mo with ammonia, water, hydroxide ions, amino acids and polyhydric alcohols, cyanide and thiocyanate ions, dimethylglyoxime and porphyrins. Qualitative reactions to the detection of these metals. The composition and biological significance of enzymes containing Zn, Fe, Cu, Co, Cr, Mn, Mo. The use of compounds of Iron, Zinc, Copper, Manganese, Molybdenum, Chromium and Cobalt in pharmaceutical analysis and medicine. Diseases caused by deficiency and excess of these bioelements.</p>	<p><i>3H-6, 3H-16, 3H-31, 3H-32, 3H-33, 3H-34, 3H-35, 3H-36, 3H-37, УМ-6 K-1, K-2, K-3, K-4, K-5, AB-1, AB-2, AB-3, AB-4</i></p>	
II-6/II-3/CPC-6	Microelements nonmetals (Se, I)	<p>Selenium: general characteristics, acid-base and redox properties of compounds. The biological role of selenium. The concept of antioxidants.</p> <p>Iodine: general characteristics as an element of group VIII. Iodide ions as ligands in complex compounds. Iodide ion detection reactions.</p> <p>Biological role of iodine compounds. The concept of chemistry of bactericidal action of iodine. The use of active iodine, as well as iodides in medicine, sanitation.</p>	<p><i>3H-5, 3H-16, 3H-38, 3H-39, УМ-5, K-1, K-2, K-3, K-4, K-5, AB-1, AB-2, AB-3, AB-4</i></p>	
II-7/II-4/CPC-7	Conditionally vital microelements nonmetals, metals and metalloids (F, B, Si, Br, Ni, V, As, Li)	<p>Special properties of fluorine as the most electronegative element. Simple substances, their chemical activity.</p> <p>General characteristics of Boron. Simple substance and its chemical activity. Biological role of boron. Antiseptic properties of boric acid and its salts.</p> <p>Silicon. General characteristics, biological role. The main difference between Silicon and Carbon is the absence of <math>\pi</math>-bonds in the compounds. Chemical bases of application of silicon compounds in medicine.</p> <p>Physiological role of Fluorine, Boron, Silicon and Bromine. Indicators of elemental status in the human body. Correction of excess and deficiency of elements in the body. The use of compounds of these elements in medicine, sanitation.</p> <p>General characteristics of the elements Lithium, Nicholas, Vanadium</p>	<p><i>3H-2, 3H-16, 3H-40, 3H-41, 3H-42, 3H-43, 3H-44, 3H-45, 3H-46, 3H-47, УМ-2 K-1, K-2, K-3, K-4, K-5, AB-1, AB-2, AB-3, AB-4</i></p>	



		<p>and Arsenic. Valence states. Chemical activity. Distribution in nature. Their binary compounds (superoxides, ozonides). Hydroxides, salts of Li, Ni, V, As and their properties and applications in medicine.</p> <p>Determination of Arsen by the March method.</p> <p>The most important compounds of Nicholas (II). Hydrolysis of salts of Nicholas (II). Complex compounds, coenzyme B12. Qualitative reaction on the Ni<sup>+2</sup> cation.</p>		
II-8/II-4/CPC-8	Potentially toxic and toxic microelements (Rb, Ag, Au, Zr, Sn, W, Ge, Ga, Sr, Ti, Al, Pb, Ba, Bi, Cd, Hg, Tl, Be, Sb)	<p>General characteristics of potentially toxic microelements. Distribution in nature. Biological role of elements in the mineral balance of the organism. General characteristics of the elements. Features of the situation in the periodic system of elements. Physiological role of potentially toxic microelements. Ways of entry into the human body. Causes of high content of potentially toxic microelements in the human body. The main manifestations of potentially toxic microelements excess in the human body. Correction of potentially toxic microelements excess in the human body.</p> <p>General characteristics of toxic microelements. Distribution in nature. Biological role of elements in the mineral balance of the organism. Characteristics of the ionic state of these microelements.</p> <p>Toxic microelement poisoning, toxicity threshold, toxic and lethal doses. Manifestations of toxicity and physiological role. Increased and decreased content of toxic microelements. Environmental pollution. Sources of elements in the human body. The ability of toxic microelements to form stable complexes. Chemical bases of application in medicine and cosmetology.</p>	<i>3H-3, 3H-4, 3H-16, 3H-19, 3H-20, VM-3, VM-4, K-1, K-2, K-3, K-4, K-5, AB-1, AB-2, AB-3, AB-4</i>	
II-9/II-5/CPC-9	The unity of the chemical composition of the organism. Metal-ligand homeostasis and its correction	<p>The essence of the chemical composition of the organism unity and its significance and the theory of metal-ligand pathologies. Pathologies in the life of the human body associated with abnormal content of certain chemical elements.</p> <p>The most important bioligands, their isomerism. Basic elements and functional groups in the composition of bioligands. Ligand properties of complexones and drugs. Chelation therapy.</p>	<i>3H-11, 3H-12, 3H-20, VM-11, VM-13, K-1, K-2, K-3, K-4, K-5, AB-1, AB-2, AB-3, AB-4</i>	
II-10/II-5/CPC-10	Inorganic drugs based on coordination compounds	<p>Drugs based on metals and metalloids. Application of inorganic compounds of Oxygen, Sulfur, Chlorine, Bromine, Nitrogen in medicine. Drugs based on coordination compounds of non-metals and metalloids (Boron, Phosphorus, Antimony, Arsenic, Selenium, Tellurium).</p> <p>Medicines based on metals and coordination compounds of metals</p>	<i>3H-15, 3H-14, VM-14 K-1, K-2, K-3, K-4, K-5, AB-1, AB-2, AB-3, AB-4</i>	

(Mg, Ca, Al, Cu, Ag, Hg, Zn, Au). The use of metals as probes in biochemical research.

## 8. Verification of results

### Current control

*Is realized during the practical classes and aims at checking the learning of educational material.*

*The form of the current control assessment during the classes is defined by syllabus of discipline. Forms of current educational activities assessment are standardized and include the control of theoretical and practical training. The 4-point (traditional) scale is used in evaluating the learning of each topic for current educational activity taking into account the approved evaluation criteria.*

Learning outcome code	Code of classes type	The method of learning outcomes verification	Criteria of evaluation
<p>3H-1, 3H-2, 3H-3, 3H-4, 3H-5, 3H-6, 3H-7, 3H-8, 3H-9, 3H-10, 3H-11, 3H-12, 3H-13, 3H-14, 3H-15, 3H-16, 3H-17, 3H-18, 3H-19, 3H-20, 3H-21, 3H-22, 3H-23, VM-2, VM-4, VM-5, VM-6, VM-7, VM-8, VM-10, VM-11, VM-13, VM-16, VM-17, VM-18, VM-19,</p>	<p>П-1,Л-1,CPC-1, П-2,Л-1,CPC-2, П-3,Л-2,CPC-3, П-4, Л-2,CPC-4, П-5, Л-2,CPC-5, П-6,Л-3,CPC-6, П-7,Л-3,CPC-7, П-8,Л-3,CPC-8, П-9,Л-4,CPC-9, П-10,Л-5,CPC-10, П-11, CPC-11, П-12,CPC-12, П-13,Л-6,CPC-13, П-14,Л-6,CPC-14, П-15,Л-7,CPC-15, П-16/Л-7/CPC-16</p>	<p>The current control is a regular check of educational trained achievements, spent by the teacher on current employment according to syllabus of the discipline.</p> <p>It is performed at each practice class according to specific objectives. Theoretical students' self-preparation control is performed in writing by answering 18 multiple choice questions in the form one-of-five, the correct answer to each is estimated at 1 point, and two numerical problems, the correct solving being estimated at 2 points.</p>	<p>The minimum number of points that a student must gain for the crediting the theoretical part is 9 points</p>

<i>УМ-40, К-1, К-2, К-3, К-4, К-5, К-6, К-7, АБ-2, АБ-4</i>			
<i>УМ-1, УМ-2, УМ-3, УМ-4, УМ-5, УМ-6, УМ-7, УМ-8, УМ-9, УМ-10, УМ-11, УМ-12, УМ-13, УМ-14, УМ-15, УМ-16, УМ-17, УМ-18, К-1, К-2, К-3, К-4, К-5, К-6, К-7, АБ-1, АБ-2, АБ-3, АБ-4</i>	П-1,Л-1,СРС-1, П-2,Л-1,СРС-2, П-3,Л-2,СРС-3, П-4,СРС-4, П-5,СРС-5, П-6,Л-3,СРС-6, П-7,Л-3,СРС-7, П-8,Л-3,СРС-8, П-9,Л-4,СРС-9, П-10,Л-5,СРС-10, П-11, СРС-11, П-12,СРС-12, П-13,Л-6,СРС-13, П-14,Л-6,СРС-14, П-15,Л-7,СРС-15, П-16/Л-7/СРС-16	The practical skills gained and the laboratory experiments carrying out assessment is performed after the laboratory work fulfilling by assessing the quality and fullness of its performance, the ability to interpret the obtained results. For the practical part of the lesson the student can get: - 4 points if laboratory work is completely fulfilled and the student correctly explains the experiments interpret the results and make conclusions; - 2 points if the laboratory work is done with some errors, the student can not fully explain and summarize the obtained results; - 0 points if the laboratory work is not performed or the student can not explain and summarize the obtained results.	The minimum number of points that a student must gain for the crediting the theoretical part is 9 points
<b>Final control</b>			
General evaluation system	The maximal assessment of current progress in a semester makes 60 % from a final assessment of knowledge on discipline, and the maximal assessment of examination makes 40 % from a final assessment of knowledge on discipline.		
Grading scales	Traditional 4-point scale, multi-point (200-point) scale, ECTS rating scale.		
Conditions of admission to the final control	The student attended all practical classes and received at least 72 points for current performance.		

Exam	Semester exam – a form of final control of mastering of student theoretical and practical material from academic discipline. The final control is carried out in the form of a written exam, using the Misa training platform, according to the schedule. It lasts for 2 academic hours. It should be performed in writing as 80 MCQs (multiple choice questions: 1 point for each correct answer).	<i>Maximum quantity of points</i> – 80 points (1 point for each MCQ task); <i>Maximum quantity of points, which the student can collect on the exam makes 80 points.</i> <i>Minimum quantity of points on the exam – not less than 50.</i>
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**The highest possible score points** which a student can gain for the current educational activity for the semester for admission to the exam is 120 points.  
**Minimal number of score points** which a student must gain for current educational activity for the semester for admission to the exam is 72 points.  
**Calculation of the points number** is based on grades gained by student under the traditional scale (by calculation of the arithmetic mean (AM) rounded to two decimal places). The resulting value is converted into points by multi-points scale as follows:

$$x = \frac{CA \times 120}{5}$$

### 9. Course policy

The policy of the course is determined by the system of requirements for the student in the study of the discipline "General and Inorganic Chemistry" and is based on the:

Regulations of the educational activity (<https://cutt.ly/3ySk64r>);

Regulations of the evaluation criteria (<https://cutt.ly/lySlyw0>);

Regulations of the academic integrity (<https://cutt.ly/EySkNHu>))

### 10. Recommended literature

#### Required course textbooks:

1. V.O. Kalibabchuk, V.I. Halynska, L.I. Hryshchenko et al. Medical Chemistry. – AUS MEDICINE Publishing. – 2010. – 224 p.
2. Raymond Chang. Chemistry (6th Edition). – WCB/McGraw-Hill. – 1998. – 995 p.
3. Steven S. Zumdahl. Chemistry (4th Edition). – Houghton Mifflin Company. – 1997. – 1031 p.
4. Gary L. Miessler, Donald A. Tarr. Inorganic Chemistry. – Prentice Hall. – 1991. – 625 p.

#### Additional books:

1. Rodney J. Sime Physical Chemistry. Methods. Techniques. Experiments. – Saunders College Publishing. – 1990. – 806 p.
2. John McMurry, Robert C. Fay. Chemistry (3rd Edition). – Prentice Hall. – 2001. – 1067 p.
3. David E. Goldberg. Fundamentals of Chemistry (2nd Edition). – WCB/McGraw-Hill. – 1998. – 561 p.
4. Theodore L. Brown, H.Eugene LeMay, Bruce E. Bursten. Chemistry. The Central Science. – Prentice Hall. – 2000. – 1017 p.
5. John Olmsted III, Gregory M. Williams. Chemistry. The Molecular Science. – Mosby. – 1994. – 977 p.

### 11. Equipment, material, technical and software support of the Course

#### Methodological support:

-Working program of the discipline;

- Multimedia support of lectures
- Lecture thesis from the discipline;
- Methodical recommendations for teachers;
- Educational platform Misa;
- Methodical recommendations for practical classes for students;
- Methodical manual for students' independent work;
- Test and control tasks for practical classes;
- Questions and tasks for final control (exam).

The department is provided with rooms for practical classes and control activities on the discipline in small groups. Laboratories are equipped with the necessary chemical utensils, reagents, devices.

### 12. Additional Information

Responsible for the educational process at the department – Associate Professor Volodymyr Rohovyk, [rohovyk@i.ua](mailto:rohovyk@i.ua)

There is a scientific students' association at the department.

During the lectures and practical classes students must have laboratory coats and hats.

Practical classes are held in the classrooms of the department at the address: 52 Pekarska street, 2<sup>nd</sup> floor and 3a Shimzeriv street, Theoretical building, 4<sup>th</sup> floor.

Department website: <https://cutt.ly/VyLt4BL>.

[kaf\\_genchemistry@meduniv.lviv.ua](mailto:kaf_genchemistry@meduniv.lviv.ua)

The Syllabus was developed by:

M.I. Sulyma, PhD in Pharmacy, Assist.Prof.

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Head of the Department

I.V. Drapak, DSc, PhD, Prof.

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