

**NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES  
OF UKRAINE**

Department of Analytical and Bioinorganic Chemistry and Water quality

**APPROVED**

by the Dean of the Faculty of Veterinary  
Medicine



Oleksandr VASHCHUK

**ACCEPTED**

at the meeting of the Department of  
Bioinorganic and Analytical Chemistry  
and Water Quality

Minutes No.10 of "13" May 2026

Head of the Department

Tetyana USHCHAPIVSKA

**REVIEWED**

Guarantor of the Educational Programme  
"H6 Veterinary Medicine"

Volodymyr MELNYK

**AGREED**

Head of the Bioethics Commission of NUBiP

Oleh MELNYK

**CURRICULUM OF ACADEMIC DISCIPLINE  
INORGANIC CHEMISTRY**

Area of knowledge H – Agriculture, forestry, fisheries and veterinary medicine

Specialty H6 – Veterinary Medicine

Academic programme Veterinary Medicine

Faculty of Veterinary Medicine

Developed by: Olha KRAVCHENKO Assoc. prof, PhD associated professor of  
Department of Analytical and Bioinorganic Chemistry and Water Quality

## Description of the discipline “INORGANIC CHEMISTRY”

Inorganic Chemistry is a fundamental discipline that studies the properties, structure, reactions and methods of obtaining inorganic substances. The course pays attention to the structure of the atom, the periodic law and the periodic system of chemical elements, chemical bonding and types of crystal lattices, acid-base properties of substances, redox processes and electrochemistry. Special emphasis is placed on the study of chemical elements that are important in veterinary medicine (calcium, phosphorus, sodium, potassium, chlorine, etc.), as well as toxic elements that can affect animal health.

The discipline develops in students the ability to understand chemical processes occurring in the animal body and the environment, and to assess the possible harmful effects of chemical compounds. Knowledge of inorganic chemistry is necessary for further study of biochemistry, toxicology, pharmacology and clinical disciplines of veterinary medicine. Studying the subject contributes to the development of analytical thinking and the ability to apply acquired knowledge in the professional activities of a veterinarian.

<b>Area of knowledge, specialty, academic programme, academic degree</b>		
Academic degree	<i>master's</i>	
Specialty	<i>H6 – Veterinary medicine</i>	
Academic programme	<i>Veterinary medicine</i>	
<b>Characteristics of the discipline</b>		
Type	Compulsory	
Total number of hours	90	
Number of ECTS credits	3	
Number of modules	3	
Course project (work) (if any)		
Form of assessment	<i>exam</i>	
<b>Indicators of the discipline for full-time and part-time forms of university study</b>		
	<b>University study</b>	
	<b>Full-time</b>	<b>Part-time</b>
Year of study		
Term		
Lectures	<i>15 hours</i>	<i>hours</i>
Practical classes and seminars	<i>45 hours</i>	<i>hours</i>
Laboratory classes	<i>hours</i>	<i>hours</i>
Self-study	<i>30 hours</i>	<i>hours</i>
Number of hours per week for full-time students	<i>4 hours</i>	

## **1. Aim, competences and expected learning outcomes of the discipline**

Aim is provide students with fundamental knowledge of inorganic chemistry necessary for understanding chemical processes in living organisms and the interaction of the animal body with the environment, as well as to develop chemical literacy for further study of related disciplines (biochemistry, pharmacology, toxicology, physiology).

### **Acquisition of Competencies:**

*Integral Competence (IC):* Ability to solve complex tasks and problems in the field of veterinary medicine, involving research and/or innovation and characterized by uncertainty of conditions and requirements.

GC 1. Ability for abstract thinking, analysis, and synthesis.

GC 2. Ability to apply knowledge in practical situations.

GC 3. Knowledge and understanding of the subject area and profession.

GC 8. Ability to learn and master modern knowledge.

GC 13. Ability to make decisions and act in compliance with the principle of intolerance to corruption and any other manifestations of dishonesty.

*Special (Professional) Competencies (SC):*

SC 1. Ability to identify the structural and functional features of cells, tissues, organs, their systems and apparatuses of the organism of animals of different classes and species – mammals, birds, insects (bees), fish, and other vertebrates.

### **Programme Learning Outcomes (PLO):**

PLO 1. To know and correctly use the terminology of veterinary medicine.

PLO 3. To determine the essence of physico-chemical and biological processes occurring in the animal organism under normal and pathological conditions.

### **Day One Competences in accordance with European Union requirements:**

1. Demonstrate understanding of the ethical and legal framework within which a veterinary doctor must operate, including professional aspects, animal welfare, animal owners, public health, social and environmental aspects related to professional activity.
2. Understand scientific research methods, the contribution of fundamental and applied research to science, and the implementation of the 3Rs principle (Replacement, Reduction, Refinement).
3. Use professional skills to contribute to the development of veterinary knowledge and implementation of the “One Health” concept in order to promote the health, safety, and welfare of animals, humans, and the environment, as well as to achieve the UN Sustainable Development Goals.
4. Collect, store, and transport samples; select appropriate diagnostic tests; interpret results; and understand the limitations of test results.
5. Correctly and responsibly prescribe and dispense medicines to patients in accordance with legislation and current guidelines.

## 2. Programme and structure of the discipline

Modules and topics	Number of hours						
	full-time						
	weeks	total	including				
l			p	lab	ind.	s.st.	
<b>Module №1. Atomic-molecular theory and the basic laws of chemistry. The structure of matter and the periodic law of D.I. Mendeleev.</b>							
Topic #1. Chemistry in the system of natural sciences. Basic laws of chemistry	2	11	1		2		4
Topic #2. Classification and nomenclature of inorganic compounds	2	11			7		2
Topic #3. "Structure of the atom. Periodic law of D.I. Mendeleev".	2	6	2				2
Topic #4. The nature of the chemical bond and the structure of chemical compounds	1	12	2		6		2
<b>Total for module 1</b>	<b>30</b>		<b>5</b>		<b>15</b>		<b>10</b>
<b>Module №2. Solutions. Properties of solutions Equilibrium in electrolyte solutions</b>							
Topic #5 "The theory of solutions. Ways of expressing the composition of solutions. Colligative properties of solutions	1	8	2				3
Topic #6. Theory of strong and weak electrolytes Theories of acids and bases	2	15	1		7		3
Topic #7. Protolytic processes (hydrolysis)	2	17	2		8		4
<b>Total for module 2</b>	<b>30</b>		<b>5</b>		<b>15</b>		<b>10</b>
<b>Module №3. Redox reactions. Complex compounds.</b>							
Topic #8. Electron transfer reactions	2	22	3		9		5
Topic #9. Reactions of complex formation	2	18	2		6		5
<b>Total for module 3</b>	<b>30</b>		<b>5</b>		<b>15</b>		<b>10</b>
<b>Total hours</b>	<b>90</b>		<b>15</b>		<b>45</b>		<b>30</b>

## 3. Topics of lectures

No.	Topic	Hours
<b>Module №1. Atomic-molecular theory and the basic laws of chemistry. The structure of matter and the periodic law of D.I. Mendeleev.</b>		
1	Introduction to Inorganic chemistry : a modern view. The role of chemistry in animal health, physiology, pharmacology, and environmental safety.	2
2-3	Atomic structure and Chemical Bond	3
<b>Module №2. Solutions. Properties of solutions Equilibrium in electrolyte solutions</b>		
4	Solutions and methods of expressing concentration. Preparation of solutions used in veterinary practice.	2
5	Hydrolysis of Salts and Acid-Base Balance in Animal Organisms	2
6	Solutions and methods of expressing concentration. Preparation of solutions used in veterinary practice.	2
<b>Module №3. Redox reactions. Complex compounds.</b>		
7	Oxidation-Reduction Reaction (RedOx)	2
8	Complex (Coordination) Compounds and Their Biological Role	2
<b>Total</b>		<b>15</b>

#### 4. Topic of practical classes

No.	Topic	Hours
<b>Module №1. Atomic-molecular theory and the basic laws of chemistry. The structure of matter and the periodic law of D.I. Mendeleev.</b>		
1.1	Main Classes of Inorganic Compounds and Their Importance in Veterinary Medicine	4
1.2	Control Work "Inorganic Compounds Used in Veterinary Medicine"	2
1.3	Seminar "Atomic structure and properties of compounds"	4
1.4	Control work "Atomic structure"	2
1.5	Control work "Chemical bond"	2
<b>Module №2. Solutions. Properties of solutions Equilibrium in electrolyte solutions</b>		
2.1	Solutions. Reactions in Electrolyte Solutions. Preparation of Solutions Used in Veterinary Practice	2
2.2	Control work "Solution. The chemical properties of electrolyte solutions.	2
2.3	Theory of Strong and Weak Electrolytes. Acids and Bases in Biological Systems. Electrolytic Dissociation	4
2.4	Control work "Electrolytic dissociation"	2
2.5	Hydrolysis of Salts and Its Role in Biological Processes	4
2.6	Control work "Hydrolysis of salt"	2
<b>Module №3. Redox reactions. Complex compounds.</b>		
3.1	Redox reactions. Experimental study of the influence of the environment on the course of redox reactions.	8
3.2	Control work "Redox reactions"	2
3.3	Coordination Compounds. Experimental Study of Their Preparation and Chemical Properties in Veterinary Medicine	3
3.4	Control test "Coordination compounds"	2
<b>Total</b>		<b>45</b>

#### 5. Topics of self-study

No.	Topic	Hours
<b>Module №1. Atomic-molecular theory and the basic laws of chemistry. The structure of matter and the periodic law of D.I. Mendeleev.</b>		
1.1	The Interconversion between Different Classes of Inorganic Compounds in Biological and Veterinary Systems	10
<b>Module №2. Theoretical and methodological principles of agroecological monitoring</b>		
2.1	Chemical kinetics. Basic concepts of chemical thermodynamics.	10
<b>Module №3. Redox reactions. Complex compounds</b>		
3.1	Elements in Veterinary Medicine: Role, Sources, Deficiency and Excess Effects	10
<b>Total</b>		<b>30</b>

#### 6. Methods of assessing expected learning outcomes:

- oral or written survey;
- interview;
- test;
- defending laboratory/practical, design/graphical works, projects;
- poster defending
- peer-to-peer assessment, self-assessment.

## 7. Teaching methods:

- problem-based method;
- practice oriented studying method;
- case method;
- project education method;
- flipped classroom, mixed education method;
- research based method;
- learning discussions and debates method;
- team work, brainstorm method
- gamification studying method.

## 8. Results assessment.

The student's knowledge is assessed by means of a 100-point scale converted into the national grades according to the "Exam and Credit Regulations at NULES of Ukraine" in force

### 8.1. Distribution of points by types of educational activities

Educational activity	Results	Assessment
<b>Module №1. Atomic-molecular theory and the basic laws of chemistry. The structure of matter and the periodic law of D.I. Mendeleev.</b>		
Lab 1.1 The main classes of inorganic compounds	ELO 1. Know and correctly use the terminology of veterinary medicine, including the place of chemistry among the main natural sciences, the main classes of inorganic compounds and the relationship between them the importance of studying chemistry for veterinary medicine main types of inorganic compounds (oxides, acids, bases, salts).the importance of such reactions in physiological and veterinary-relevant environments, the main classes of the structure of the atom and how it influences the chemical properties of substances.	<b>10</b>
Self-Study 1.1 "The interconversion between different classes of inorganic compounds"		<b>15</b>
Lab 1.2 "Control work" Classes of inorganic compounds"		<b>20</b>
Lab 1.3 "Seminar "Atomic structure and properties of compounds"		<b>5</b>
Lab 1.4 "Control work "Atomic structure"		<b>10</b>
Lab 1.5 "Control work "Chemical bond"		<b>20</b>
Module control test 1.		<b>20</b>
<b>Total for module 1</b>		<b>100</b>
<b>Module №2. Theoretical and methodological principles of agroecological monitoring</b>		
Self-Study 2.1"Chemical kinetics. Basic concepts of chemical thermodynamics"	ELO 3. Determine the essence of physicochemical and biological processes that occur in the animal body in normal and pathological conditions, including preparation solutions of given concentration using appropriate laboratory techniques, the chemical properties of electrolyte solutions and their relevance to animal physiology, the process of electrolytic dissociation and	<b>5</b>
Lab 2.1 Solutions. Reactions of solutions of electrolytes. The preparation of solutions of a given concentration		<b>10</b>
Lab 2.2 Control work "Solution. The chemical properties of		<b>25</b>

electrolyte solutions.	distinguish between strong and weak electrolytes.	
Lab 2.3 Theory of strong and weak electrolytes. Theories of acids and bases. Electrolytic dissociation.	the theory of electrolytes to explain physiological processes such as ion transport and pH balance in animals.the process of salt hydrolysis and predict the resulting solution pH, the impact of salt hydrolysis in natural water sources and animal digestive systems.	<b>5</b>
Lab 2.4 Control work “Electrolytic dissociation”		<b>15</b>
Lab 2.5 Hydrolysis of salt		<b>5</b>
Lab 2.6. Control work ‘Hydrolysis salt’		<b>20</b>
Module control test 2.		<b>20</b>
<b>Total for module 2</b>		<b>100</b>
<b>Module №3. Redox reactions. Complex compounds</b>		
Lab 3.1 Redox reactions. Experimental study of the influence of the environment on the course of redox reactions.	ELO 1,3. Know and correctly use the terminology of veterinary medicine and Determine the essence of physicochemical and biological processes that occur in the animal body in normal and pathological conditions including redox reactions, the influence of environmental factors on redox processes in biological and agricultural systems,the structure and bonding of coordination compounds, their preparation and analyze their chemical properties, particularly in veterinary pharmaceuticals and diagnostics, biologically essential elements (e.g., Fe, Zn, Cu, I, Se, Ca) signs and biochemical consequences of element deficiencies or toxic excess in animals.	<b>5</b>
Lab 3.2 Control work "Redox reactions"		<b>30</b>
Lab 3.3 Coordination compounds. Experimental study of methods of their preparation and study of chemical properties.		<b>5</b>
Lab 3.4. Control test "Coordination compounds"		<b>20</b>
Self-study 3.1 Elements in Veterinary Medicine: Role, Sources, Deficiency and Excess Effects	elemental imbalances to metabolic disorders, applying redox and coordination chemistry principles	<b>20</b>
Module control test 3		<b>20</b>
<b>Total for module 3</b>		<b>100</b>
<b>Class work</b>	<b><math>(M1 + M2+M3)/3*0,7 \leq 70</math></b>	
<b>Exam</b>	<b>30</b>	
<b>Total for discipline</b>	<b><math>(\text{Class work} + \text{exam}) \leq 100</math></b>	

### 8.2. Scale for assessing student’s knowledge

Student’s rating, points	National grading (exam/credits)
90-100	excellent
74-89	good
60-73	satisfactory
0-59	unsatisfactory

### Assessment policy

<b>Deadlines and exam retaking rules</b>	Works that are submitted late without valid reasons will be assessed with a lower grade. Module tests may be retaken with the permission of the lecturer if there are valid reasons (e.g. a sick leave).
<b>Academic integrity rules</b>	Cheating during tests and exams is prohibited (including using mobile devices). Plagiarism and unauthorized use of AI are strictly prohibited. All work must be completed independently. Violations may result in a failing grade or further disciplinary measures. Term papers and essays must have correct references to the literature used
<b>Attendance rules</b>	Attendance is compulsory. For good reasons (e.g. illness, international internship), training can take place individually (online by the faculty dean's consent)

### 9. Teaching and learning aids:

1. e-learning course of the discipline (<https://elearn.nubip.edu.ua/course/view.php?id=2610>); abstracts of lectures and their presentations (in electronic form);
2. textbooks, training aids, workshops;
3. Inorganic Chemistry. Methodological guidelines for laboratory practice and independent work For bachelor students Specialty 211 – “Veterinary medicine” Експодрук 2024 – Voitenko L.V., Kopilevich V.A., Prokopchuk N.M., Kravchenko O.O. Ushapivska T.I.
4. Inorganic chemistry Part 2. Chemistry of the elements Methodological guidelines for laboratory practice and independent work Specialty 211 – “Veterinary medicine” Експодрук 10 д.а Ushchapivska T., Kravchenko O., Abarbarchuk L.

### 10. Recommended sources of information

1. Gliessman, S. R. (2021). Package price agroecology: The ecology of sustainable food systems. CRC press
2. Voitenko L. Chemistry with the foundations of biogeochemistry: manual. Kyiv: Naukova stolytsa, 2019. 400 p. (In Ukrainian).
3. Gliessman, S. R., Méndez, V. E., Izzo, V. M., & Engles, E. W. (2022). Agroecology: Leading the transformation to a just and sustainable food system. CRC Press.
4. Ecology of agrosphere (handbook): [https://www.agroeco.org.ua/wp-content/uploads/Publications/ecology\\_agrosphere.pdf](https://www.agroeco.org.ua/wp-content/uploads/Publications/ecology_agrosphere.pdf)
5. SEGAE: a serious game to learn agroecology <https://www.segae.org/game/>
6. Chobotar, V. V., Kopilevich, V. A., & Kravchenko, O. O. (2024). Analysis of Natural Water Quality in the Dniester River Basin for Economic

- Utilization. *Journal of Water Chemistry and Technology*, 46(6), 636-644.  
<https://doi.org/10.3103/S1063455X24060031>
7. Chobotar, V., Kravchenko, O., & Tkalenko, H. (2024). Effectiveness of nanoaquachelates of transition metals against scab in industrial apple plantations. *Quarantine and plant protection*, (4), 29-35.  
<https://doi.org/10.36495/2312-0614.2024.4.29-35>
  8. Hnatiuk, T., Kravchenko, O., Abarbarchuk, L., Churilov, A., & Chobotar, V. (2023). Influence of drugs produced by electropulse ablation methods on the development of soybean phytopathogenic bacteria. *Plant and Soil Science*, 14(3), 22-34. <https://doi.org/10.31548/plant3.2023.22>
  9. Antraptseva, N. M., Kochkodan, O. D., Solod, N. V., & Kravchenko, O. O. (2023). The behavior of  $\text{Co}_{3-x}\text{M}^{\text{II}}_x(\text{PO}_4)_2 \cdot 8\text{H}_2\text{O}$  ( $\text{M}^{\text{II}} = \text{Mg}, \text{Mn}, \text{Zn}$ ) solid solutions at elevated temperatures. *Functional materials*, 30(4), 519-525.  
<https://doi.org/10.15407/fm30.04.519>
  10. Antraptseva N., Solod N., Kochkodan O., Kravchenko O. (2022), Co-precipitation of cations of zinc and divalent metals from phosphoric acid solutions, *Functional Materials*, 29(4), pp. 597–604,  
<https://doi.org/110.15407/fm29.04.597>
  11. Kravchenko, O. O., et al. "Sensitivity of phytopathogenic and nodule bacteria of soybeans to microelements preparations obtained by electropulse ablation." *Науковий журнал «Біологічні системи: теорія та інновації»* 12.1 (2021): 36-43.  
<http://dx.doi.org/10.31548/biologiya2021.01.004>
  12. Antraptseva, N., Solod, N., & Kravchenko, O. (2021). Features of the synthesis of solid solutions of divalent metal phosphates with a newberyite structure. *Functional Materials*, 28(3), 573-579.  
<https://doi.org/10.15407/fm28.03.573>
  13. Antraptseva, N., Solod, N., & Kravchenko, O. (2020). Influence of crystal hydrate water on the process and products of heat treatment of magnesium-manganese (II) of dihydrogen phosphates. *Functional Materials*, 27(4), 820-826. <https://doi.org/10.15408/fm.27.04.820>
  14. Kravchenko, O et al. Порівняльна оцінка якості питної води окремих населених пунктів Могилів Подільського району Вінницької області. *Науковий журнал «Біологічні системи: теорія та інновації»*, (2020): v. 11, n. 3, p. 63-73, <http://dx.doi.org/10.31548/biologiya2020.03.007>.

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