

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

Department of Analytical and Bioinorganic Chemistry and Water quality

**APPROVED**

Faculty of Veterinary medicine

“ 9 ”June” 2025

**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 Veterinary medicine

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## 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.

Area of knowledge, specialty, academic programme, academic degree		
Academic degree	master's	
Specialty	H6 – Veterinary medicine	
Academic programme	Veterinary medicine	
Characteristics of the discipline		
Type	Compulsory	
Total number of hours	120	
Number of ECTS credits	4	
Number of modules	3	
Course project (work) (if any)		
Form of assessment	exam	
Indicators of the discipline for full-time and part-time forms of university study		
	University study	
	Full-time	Part-time
Year of study		
Term		
Lectures	15 hours	hours
Practical classes and seminars	45 hours	hours
Laboratory classes	hours	hours
Self-study	60 hours	hours
Number of hours per week for full-time students	4 hours	

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

Aim is to provide students with basic knowledge of the basics 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 form chemical literacy for further mastery of related disciplines (biochemistry, pharmacology, toxicology, physiology).

### ***Competences acquired:***

Integral competence (IC): Ability to solve complex tasks and problems in the field of veterinary medicine, which involves conducting research and/or implementing innovations and is characterized by uncertainty of conditions and requirements.

#### General competence (GC):

GC 1. Ability to think abstractly, analyze and synthesize.

GC 7. Ability to conduct research at the appropriate level.

GC 11. Ability to evaluate and ensure the quality of work performed.

#### Special (professional) competence (SC):

SC 7. Ability to organize and conduct laboratory and special diagnostic tests and analyze their results.

### ***Expected learning outcomes (ELO):***

ELO 1. Know and correctly use the terminology of veterinary medicine.

ELO 3. Determine the essence of physicochemical and biological processes that occur in the animal body in normal and pathological conditions.

## **2. Programme and structure of the discipline**

Modules and topics	Number of hours						
	full-time						
	weeks	total	including				
			l	p	lab	ind.	s.st.
Module №1. Atomic-molecular theory and the basic laws of chemistry. The structure of matter and the periodic law of D.I. Mendeleev.							
Topic #1. Chemistry in the system of natural sciences. Basic laws of chemistry	2	11	1		2		8
Topic #2. Classification and nomenclature of inorganic compounds	2	11			7		4
Topic #3. “Structure of the atom. Periodic law of D.I. Mendeleev ”.	2	6	2				4
Topic #4. The nature of the chemical bond and the structure of chemical compounds	1	12	2		6		4
Total for module 1	40		5		15		20
Module №2. Solutions. Properties of solutions Equilibrium in electrolyte solutions							
Topic #5 “The theory of solutions. Ways of expressing the composition of solutions. Colligative properties of solutions	1	8	2				6
Topic #6. Theory of strong and weak electrolytes Theories of acids and bases	2	15	1		7		7
Topic #7. Protolytic processes (hydrolysis)	2	17	2		8		7
Total for module 2	40		5		15		20
Module №3. Redox reactions. Complex compounds.							
Topic #8. Electron transfer reactions	2	22	3		9		10
Topic #9. Reactions of complex formation	2	18	2		6		10
Total for module 3	40		5		15		20
Total hours	120		15		45		60

### 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.	2
2-3	Atomic structure and Chemical Bond	3
<b>Module №2. Solutions. Properties of solutions Equilibrium in electrolyte solutions</b>		
4	Theory of electrolytic dissociation	2
5	Hydrolysis of salts	2
6	Solutions. Concentration of solutions	2
<b>Module №3. Redox reactions. Complex compounds.</b>		
7	Oxidation-Reduction Reaction (RedOx)	2
8	Complex (Coordination) compounds	2
<b>Total</b>		<b>15</b>

### 4. Topic of laboratory work

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 main classes of inorganic compounds	4
1.2	Control work "Classes of inorganic compounds"	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 of solutions of electrolytes. The preparation of solutions of a given concentration	2
2.2	Control work "Solution. The chemical properties of electrolyte solutions."	2
2.3	Theory of strong and weak electrolytes. Theories of acids and bases. Electrolytic dissociation.	4
2.4	Control work "Electrolytic dissociation"	2
2.5	Hydrolysis of salt	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 methods of their preparation and study of chemical properties.	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	20
<b>Module №2. Theoretical and methodological principles of agroecological monitoring</b>		
2.1	Chemical kinetics. Basic concepts of chemical thermodynamics.	20
<b>Module №3. Redox reactions. Complex compounds</b>		
3.1	Elements in Veterinary Medicine: Role, Sources, Deficiency and Excess Effects	20
<b>Total</b>		<b>60</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
Module №1. Atomic-molecular theory and the basic laws of chemistry. The structure of matter and the periodic law of D.I. Mendeleev.		
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.	10
Self-Study 1.1 “The interconversion between different classes of inorganic compounds”		15
Lab 1.2 "Control work" Classes of inorganic compounds"		20
Lab 1.3 “Seminar “Atomic structure and properties of compounds”		5
Lab 1.4 “Control work "Atomic structure"		10
Lab 1.5 “Control work "Chemical bond”		20
Module control test 1.		20
Total for module 1		100
Module №2. Theoretical and methodological principles of agroecological monitoring		
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	5
Lab 2.1 Solutions. Reactions of solutions of electrolytes. The preparation of solutions of a given		10

concentration	properties of electrolyte solutions and their relevance to animal physiology, the process of electrolytic dissociation and distinguish between strong and weak electrolytes.	
Lab 2.2 Control work "Solution. The chemical properties of electrolyte solutions.		<b>20</b>
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. elemental imbalances to metabolic disorders, applying redox and coordination chemistry principles	<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		<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

### 8.3. 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:

- 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);  
- textbooks, training aids, workshops;  
- 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.

- Inorganic chemistry Part 2. Chemistry of the elements Methodological guidelines for laboratory practice and independent work Specialty 211 – “Veterinary medicine” Експодрук 10 д.а Ushchapiivska 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  $\text{Co}_{3-x}\text{M}^{\text{II}}_x(\text{PO}_4)_2 \cdot 8\text{H}_2\text{O}$  ( $\text{M}^{\text{II}} = \text{Mg, Mn, Zn}$ ) 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>.