NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Department of Analytical and Bioinorganic Chemistry and Water quality

APPROVED
by the Dean of the Agrobiological Faculty
_____Volodymyr ZAVGORODNII
"____"_____20____

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 AP "Agronomy"
_____Volodymyr MOKRIIENKO

CURRICULUM OF ACADEMIC DISCIPLINE
INORGANIC AND ANALYTICAL CHEMISTRY

Area of knowledge H – Agriculture, forestry, fisheries and veterinary medicine
Specialty H1 – Agronomy
Academic programme Agronomy
Faculty Agrobiological
Developed by:Nadiia PROKOPCHUK Assoc. prof, PhD, associated professor of Department of Analytical and Bioinorganic Chemistry and Water Quality
Olha KRAVCHENKO Assoc. prof, PhD, associated professor of Department of Analytical and Bioinorganic Chemistry and Water Quality

Kyiv – 2026 p.

Description of the discipline

The discipline "Inorganic and Analytical Chemistry" belongs to the basic general education subjects and ensures the formation of the foundation of knowledge and skills of a specialist in the agronomic field, necessary for studying professionally oriented and special disciplines. Studying the course of the discipline is aimed at mastering knowledge about chemical laws and regularities of chemical transformations with an orientation to the processes occurring in the environment and the formation of the theoretical and practical level of students, the skills of performing a chemical experiment, necessary for mastering special subjects that use chemical analysis of natural and artificial objects. The student must be able to: use educational, methodical and reference literature on inorganic and analytical chemistry (including in elearn), carry out calculations based on the equations of chemical reactions and processes, solve calculation problems using computer technology, perform chemical reactions independently in practice, conduct laboratory research.

Area of knowledge, specialty, academic programme, academic degree		
Academic degree	*bachelor's*	
Specialty	*H1 - Agronomy*	
Academic programme	*Agronomy*	
Characteristics of the discipline		
Type	Compulsory	
Total number of hours	150	
Number of ECTS credits	5	
Number of modules	4	
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	*30 hours*	*hours*
Practical classes and seminars	*75 hours*	*hours*
Laboratory classes	*hours*	*hours*
Self-study	*45 hours*	*hours*
Number of hours per week for full-time students	*7 hours*	

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

Aim is to build a good foundation in chemical knowledge that allows to make qualitative and quantitative inquiries into topics in natural science.

Competences acquired:

Integral competence (IC): The ability to solve complex specialized tasks and practical problems in agronomy, which involves the application of theories and methods of the relevant science and is characterized by complexity and compliance with zonal conditions

General competence (GC):

GC 7: Ability to apply knowledge in practical situations;
GC 8: Skills for carrying out safe activities;
GC 9. Ability to search, process and analyze information from various sources;
GC 11: The desire to preserve the environment.

Special (professional) competence (SC):

SC 7: The ability to scientifically substantiate the use of fertilizers and plant protection products, considering their chemical and physical properties and impact on the environment;

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

ELO 6. Demonstrate knowledge and understanding of fundamental disciplines to the extent necessary for mastery of relevant skills in the field of agronomy;
ELO 10. Analyze and integrate knowledge from general and special professional training to the extent necess;

2. Programme and structure of the discipline

Modules and topics	Number of hours												
	Full time							Part time					
	Weeks	Total	including					Total	including				
			l	p	lab	ind	St.s		l	p	lab	ind	St.s
1	2	3	4	5	6	7	8	9	10	11	12	13	14
Module №1. **Theoretical foundations of inorganic chemistry. The Main Laws of chemical transformations**													
Topic #1. Introduction. General notions, stoichiometrical laws and types of chemical reactions	1	12	2	-	6	-	2						
Topic #2. Atomic structure of chemical elements. Electronic formulas	1	12	2	-	4	-	3						
Topic #3. The Periodic Law and Periodic Table of chemical elements	1	6	2	-	-	-	2						
Topic #4. Chemical bonding and structure of molecule. Chemical kinetics and equilibrium	1	12	2	-	4	-	3						
Total hours (module 1)	**42 hours**		**8**	**-**	**14**	**-**	**20**						
Module №2. **Chemical transformations with change of oxidation number of elements or their valence**													
Topic #5. Solutions, their nature and properties. Hydrolysis of salts	1	12	2	-	6	-	2						
Topic #6. Red-Ox reactions	1	16	2	-	8	-	2						
Topic #7. General properties of non-metals	1	8	2	-	2	-	2						

Topic #8. General properties of metals	1	8	2	-	2	-	2						
Topic #9. Coordination compounds	1	10	2	-	6	-	2						
Total hours (module 2)	**54 hours**		**10**	**-**	**24**	**-**	**10**						
Module №3. **Principles and methods of Qualitative Analysis of Cations and Anions**													
Topic #10. Introduction to Analytical chemistry	1	28	2	-	15	-	5						
Topic #11-12. Qualitative analysis. The main principle of qualitative analysis of unknown substances	2	20	4	-	8	-	8						
Total hours (module 3)	**48 hours**		**6**	**-**	**23**	**-**	**13**						
Module №4. **Theoretical and experimental foundations of Quantitative chemical analysis. Gravimetry and neutralization method. Red Ox methods and complexing methods.**													
Topic #13. Theoretical and experimental foundanion of Quntitative analysis	1	12	2	-	6	-	4						
Topic #14. Titrimetry (volumetry, volumetric analysis). Neutralization method	1	12	2	-	4	-	4						
Topic #15. Oxidation-reduction (Redox) Titration (Redoxmetry). Complexometric Titration	1	12	2		4		4						
Total hours (module 4)	**36 hours**		**6**	**-**	**14**	**-**	**12**						
Total hours	**180**		**30**	**-**	**75**	**-**	**45**						

3. Topics of lectures

№	Topic title	Total hours
Module №1. **Theoretical foundations of inorganic chemistry. The Main Laws of chemical transformations**		
1	Introduction. General notions, stoichiometrical laws and types of chemical reactions.	2
2	Atomic structure of chemical elements. Electronic formulas.	2
3	The Periodic Law and Periodic Table of chemical elements	2
4	Chemical bonding and structure of molecule. Chemical kinetics and equilibrium	2
Module №2. **Chemical transformations with change of oxidation number of elements or their valence**		
5	Solutions, their nature and properties. Hydrolysis of salts	2
6	Red-Ox reactions	2
7	General properties of non-metals	2
8	General properties of metals	2
9	Coordination compounds	2
Module №3. **Principles and methods of Qualitative Analysis of Cations and Anions**		
10	Introduction to Analytical chemistry	2
11	Qualitative analysis.	2

12	The main principle of qualitative analysis of unknown substances	2
Module №4. **Theoretical and experimental foundations of Quantitative chemical analysis. Gravimetry and neutralization method. Red Ox methods and complexing methods.**		
13	Theoretical and experimental foundanion of Quntitative analysis	2
14	Titrimetry (volumetry, volumetric analysis). Neutralization method	2
15	Oxidation-reduction (Redox) Titration (Redoxmetry). Complexometric Titration	2
Total		**30**

4. Topic of lab classes

№	Topic title	Hours
Inorganic chemistry		
Module №1. **Theoretical foundations of inorganic chemistry. The Main Laws of chemical transformations**		
1.1	The Main Classes of Inorganic Substances and Their Importance in Agronomy	4
1.2	Classification of Inorganic Substances and Their Role in Plant Nutrition	2
1.3	Atomic structure. Chemical bonding	2
1.4	Control Test "Atomic Structure. Electron configurations of atoms. Chemical bonding"	2
1.5	Theory of Electrolytic Dissociation in Soil and Fertilizer Solutions	2
1.6	Control Test "Theory of electrolytic dissociation"	2
Module №2. **Chemical transformations with change of oxidation number of elements or their valence**		
2.1	Theory of Electrolytic Dissociation in Soil and Fertilizer Solutions	4
2.2	Control Test "Hydrolysis of Salts"	2
2.3	Oxidation-Reduction Reactions in Soil and Plants	8
2.4	Control Test "RedOx reactions with products"	2
2.5	Control Test "RedOx reactions without products"	2
2.6	Complex (Coordination) Compounds and Chelated Micronutrient Fertilizers	4
2.7	Control test "Complex (coordination) compounds"	2
Total hours from the section "Inorganic chemistry": 38 hours.		
Analytical chemistry		
Module №3. **Principles and methods of Qualitative Analysis of Cations and Anions**		
3.1.	The first group of Cations	2
3.2	The second group of Cations	5
3.3	The third group of Cations	4
3.4	The fourth group of Cations	2
3.5	The first group of Anions	2
3.6	The second group of anions	2
3.7	The third group of Anions.	2

3.8	Control Test "Analysis of Unknown substance"	4
Module №4. **Theoretical and experimental foundations of Quantitative chemical analysis. Gravimetry and neutralization method. Red Ox methods and complexing methods**		
4.1	Preparation of solution	4
4.2	Control test "Concentration of Solutions"	2
4.3	Determination of alkali solution normality	4
4.4	Determination of Water Hardness	4
Total hours from the section "Analytical chemistry": 37 hours.		
Total lab hours:		**75**

5. Topics of self-study

№	Topic title	Total hours
Module №1. **Theoretical foundations of inorganic chemistry. The Main Laws of chemical transformations**		
1	Basic concepts of chemistry. Classification of inorganiBasic Concepts of Chemistry. Classification of Inorganic Substances and Their Role in Plant Nutritionc substances	10
Module №2. **Chemical transformations with change of oxidation number of elements or their valence**		
2	Chemical transformations metals and non-metals in Soil-plant System	10
Module №3. **Principles and methods of Qualitative Analysis of Cations and Anions**		
3	Analysis of unknown substances	13
Module №4. **Theoretical and experimental foundations of Quantitative chemical analysis. Gravimetry and neutralization method. Red Ox methods and complexing methods**		
4	Solutions and Fertilizer Mixtures. Methods of Expressing the Concentration of Solutions	12

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. **Theoretical foundations of inorganic chemistry. The Main Laws of chemical transformations**		
Lab. 1.1. The main classes of inorganic substances	ELO 6. Demonstrate knowledge and understanding of fundamental disciplines to the extent necessary for mastery of relevant skills in the field of agronomy; ELO 10. Analyze and integrate knowledge from general and special professional training to the extent necess;	5
Lab. 1.2. Control Test "Classification of Inorganic Substances"		25
Lab. 1.3. Atomic structure. Chemical bonding		8
Lab. 1.4. Control Test "Atomic Structure. Electron configurations of atoms. Chemical bonding"		12
Lab. 1.5. Theory of electrolytic dissociation		5
Lab. 1.6. Control Test "Theory of electrolytic dissociation"		18
Independent Study for Module #1.		12
Control Test for Module #1.		15
Totally for Module #1.		**100**
Module №2. **Chemical transformations with change of oxidation number of elements or their valence**		
Lab. 2.1. Ionic product of water. Hydrolysis of salts	ELO 6. Demonstrate knowledge and understanding of fundamental disciplines to the extent necessary for mastery of relevant skills in the field of agronomy; ELO 10. Analyze and integrate knowledge from general and special professional training to the extent necess;	5
Lab. 2.2. Control Test "Hydrolysis of Salts"		20
Lab. 2.3. Oxidation-reduction reactions		5
Lab. 2.4. Control Test "RedOx reactions with products"		10
Lab. 2.5. Control Test "RedOx reactions without products"		20
Lab. 2.6. Complex (coordination) compounds		5
Lab. 2.7. Control test "Complex (coordination) compounds"		10
Independent Study for Module		5

#2.		
Control Test for Module #2.		20
Totally for Module #2.		**100**
Module №3. **Principles and methods of Qualitative Analysis of Cations and Anions**		
Lab. 3.1. The first group of Cations	ELO 6. Demonstrate knowledge and understanding of fundamental disciplines to the extent necessary for mastery of relevant skills in the field of agronomy; ELO 10. Analyze and integrate knowledge from general and special professional training to the extent necess;	5
Lab. 3.2. The second group of Cations		10
Lab. 3.3. The third group of Cations		5
Lab. 3.4. The fourth group of Cations		5
Lab. 3.5. The first group of Anions		5
Lab. 3.6. The second group of anions		5
Lab. 3.7. The third group of Anions.		5
Lab. 3.8. Control Test "Analysis of Unknown substance"		20
Independent Study for Module #3.		20
Control Test for Module #3.		20
Totally for Module #3.		**100**
Module №4. **Theoretical and experimental foundations of Quantitative chemical analysis. Gravimetry and neutralization method. Red Ox methods and complexing methods**		
Lab. 4.1. Preparation of solution	ELO 6. Demonstrate knowledge and understanding of fundamental disciplines to the extent necessary for mastery of relevant skills in the field of agronomy; ELO 10. Analyze and integrate knowledge from general and special professional training to the extent necess;	10
Lab. 4.2. Control test "Concentration of Solutions"		40
Lab. 4.3. Determination of alkali solution normality		10
Lab. 4.4. Determination of Water Hardness		10
Independent Study for Module #4.		10
Control Test for Module #4.		20
Totaly for Module #4.		100
Class work	$(M_1+M_2+M_3+M_4)/4*0.7 \leq 70$	
Exam/credit	30	
Total for year	(Class work + exam) ≤ 100	

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

Deadlines and exam retaking rules	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).
Academic integrity rules	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
Attendance rules	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:

- electronic educational course of the educational discipline (on the educational portal of NUBiP of Ukraine eLearn https://elearn.nubip.edu.ua/course/view.php?id=2471);
- abstracts of lectures and their presentations (in electronic form);
- textbooks, training aids, workshops;
- methodical materials for the study of the academic discipline

10. Recommended sources of information

- Inorganic and Analytical Chemistry: Tutorial: [for students of higher educational institutions III-IV accreditation level, specialty 201 Agronomy»] / Savchenko D.A., Voitenko L.V., Prokopchuk N.M. – Kyiv: NULES Publ., 2018. – 480 p.
- Guidelines for laboratory practice and independent work INORGANIC AND ANALYTICAL CHEMISTRY PART # 1 INORGANIC CHEMISTRY For bachelor students Specialty 201 – "Agronomy"/Voitenko L.V., Kopilevich V.A., Prokopchuk N.M., Kravchenko O.O., Savchenko D.A. – Kyiv: Експо-Друк., 2024. - 162 p.
- Guidelines for laboratory practice and independent work INORGANIC AND ANALYTICAL CHEMISTRY PART # 2 ANALYTICAL CHEMISTRY For bachelor students Specialty 201 – "Agronomy"/Voitenko L.V., Kopilevich V.A., Prokopchuk N.M., Kravchenko O.O., Savchenko D.A. – Kyiv: Експо-Друк., 2024. - 160 p.
- General and Inorganic Chemistry: Textbook/V.O. Kalibabchuk, V.V. Ohurtsov, V.I. Halynska et al.; edited by V.O. Kalibabchuk. — Kyiv: AUS Medicine Publishing, 2020. — 456 p.

- Quantitative Chemical Analysis (10th Edition)/ Daniel C. Harris – Macmillan Learning, 2020. – 825 p.
- Inorganic Chemistry (4th Edition)/ James E. House, Canada, 2025. – 950 p.
- Toward the Development of the Ukrainian Water Quality Index Larysa V.. Voitenko, Tatiana I. Ushchapivska, Olha O.. Kravchenko, Nadiia M.. Prokopchuk, Leonid M.. Abarbarchuk 1056-SEMIT2025
- 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
- Antraptseva N.M., Solod N.V., Kravchenko O.O. Crystallization features of solid solutions of hydrated diphosphates in the system $ZnSO_4$–$CoSO_4$–$K_4P_2O_7$–H_2O. Funct. Mater. 2024; 31 (3): 396-404. https://doi.org/10.15407/fm31.03.396
- Chobotar, V.V., Kopilevich, V.A., Kravchenko, O.O. Analysis of Natural Water Quality in the Dniester River Basin for Economic Utilization. *J. Water Chem. Technol.* **46**, 636–644 (2024). https://doi.org/10.3103/S1063455X24060031

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