

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

Department of Analytical and Bioinorganic Chemistry and Water quality



**“CONFIRMED”**

Dean of agrobiological faculty

(prof. Kovalenko V. P.)

2024 p.

**“APPROVED”**

at the meeting of the department of  
Analytical and Bioinorganic chemistry  
and Water quality

Protocol №11 from “23” May 2024

Head of the Department

(prof. Kopilevich V.A.)

**”REVIEWED”**

Program Coordinator

“Agronomy”

(prof. Kovalenko V. P.)

**WORKING PROGRAM OF EDUCATIONAL DISCIPLINE  
INORGANIC AND ANALYTICAL CHEMISTRY**

Branch of knowledge Agricultural sciences and food

Specialty 201 - Agronomy

Educational program Agronomy

Faculty (Institute) Agrobiological

Developers: Assoc. prof, PhD, associated professor of Department of Analytical and Bioinorganic Chemistry and Water Quality Prokopchuk N.M., Assoc. prof, PhD associated professor of Department of Analytical and Bioinorganic Chemistry and Water Quality Kravchenko O.O

Kyiv – 2024 p.

## Description of the discipline Inorganic and Analytical Chemistry

(name)

<b>Academic degree, specialty, academic programme</b>		
Academic degree	<i>Bachelor's</i>	
Specialty	<i>201- "Agronomy"</i>	
Academic programme	<i>Agronomy</i>	
<b>Characteristics of the discipline</b>		
Type	compulsory	
Total number of hours	180	
Number of ECTS credits	6	
Number of modules	4	
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>		
	Full-time	Part-time
Year of study	1	
Semester	1	
Lectures	<i>30 hours</i>	<i>hours</i>
Practical classes and seminars	<i>hours</i>	<i>hours</i>
Laboratory classes	<i>75 hours</i>	<i>hours</i>
Self-study	<i>75hours</i>	<i>hours</i>
Number of hours per week for fulltime students	<i>7 hours</i>	

### 1. Aim, objectives, 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. Objectives:

- apply stoichiometry in determining quantity relationships for compounds and chemical reactions;
- demonstrate an understanding of chemical equilibrium;
- understand the structure of matter on atomic and molecular levels and its correlation to chemical and physical properties;
- describe the concentration of a solution in the way that is most appropriate for a particular problem or application;
- use laboratory equipment and make observations to identify chemical and physical changes.

### **Acquisition of competences:**

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 competences (GC):

*GC 7. Ability to apply knowledge in practical situations;*

*GC 8. Skills of performing safe activities;*

*GC 9. Ability to search, process and analyze information from various sources; GC 11. Efforts to preserve the environment.*

Special (professional) competences (SC):

*SC7. The ability to scientifically use fertilizers and plant protection products, considering their chemical and physical properties and impact on the environment.*

Expected Learning Outcomes (ELO):

*PLO 4. To compare and evaluate modern scientific and technical achievements in the field of agronomy;*

*PLO 6. Demonstrate knowledge and understanding of fundamental disciplines to the extent necessary for mastery of relevant skills in the field of agronomy;*

*PLO 10. Analyze and integrate knowledge from general and special professional training to the extent necessary for specialized professional work in the field of agronomy;*

## **2. Programme and structure of the discipline for: - full-time (part-time) form of study;**

Modules and topics	Hours													
	Full time							Part time form						
	Weeks	Total	including					Total	including					
			1	p	lab	ind	St.s		1	p	lab	ind	St.s	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	
<b>Module №1. Theoretical foundations of inorganic chemistry. The Main Laws of chemical transformations</b>														
Topic #1. Introduction. General notions, stoichiometrical laws and types of chemical reactions	1	12	2	-	6	-	4							
Topic #2. Atomic structure of chemical elements. Electronic form of atoms	1	12	2	-	4	-	6							

Topic #3. The Periodic Law and Periodic Table of chemical elements	1	6	2	-	-	-	4							
Topic #4. Chemical bonding and structure of molecule. Chemical kinetics and equilibrium	1	12	2	-	4	-	6							
<b>Total hours (module 1)</b>	<b>42 hours</b>		<b>8</b>	-	<b>14</b>	-	<b>20</b>							

<b>Module №2. Chemical transformations with change of oxidation number of elements or their valence</b>														
Topic #5. Solutions, their nature and properties. Hydrolysis of salts	1	12	2	-	6	-	4							
Topic #6. Red-Ox reactions	1	16	2	-	8	-	6							
Topic #7. General properties of nonmetals	1	8	2	-	2	-	4							
Topic #8. General properties of metals	1	8	2	-	2	-	4							
Topic #9. Coordination compounds	1	10	2	-	6	-	2							
<b>Total hours (module 2)</b>	<b>54 hours</b>		<b>10</b>	-	<b>24</b>	-	<b>20</b>							
<b>Module №3. Principles and methods of Qualitative Analysis of Cations and Anions</b>														
Topic #10. Introduction to Analytical chemistry	1	28	2	-	15	-	11							
Topic #11-12. Qualitative analysis. The main principle of qualitative analysis of unknown substances	2	20	4	-	8	-	8							
<b>Total hours (module 3)</b>	<b>48 hours</b>		<b>6</b>	-	<b>23</b>	-	<b>19</b>							
<b>Module №4. Theoretical and experimental foundations of Quantitative chemical analysis. Gravimetry and neutralization method. Red Ox methods and complexing methods.</b>														
Topic #13. Theoretical and experimental foundation of Quantitative analysis	1	12	2	-	6	-	4							
Topic #14. Titrimetry (volumetry, volumetric analysis). Neutralization method	1	12	2	-	4	-	6							

Topic #15. Oxidationreduction (Redox) Titration (Redoxmetry). Complexometric Titration	1	12	2		4		6						
<b>Total hours (module 4)</b>	<b>36 hours</b>	<b>6</b>	<b>-</b>	<b>14</b>	<b>-</b>	<b>16</b>							
<b>Total hours</b>	<b>180</b>	<b>30</b>	<b>-</b>	<b>75</b>	<b>-</b>	<b>75</b>							

### 3. Topics of laboratory (practical, seminar) classes

№	Topic title	Hours
<i>Inorganic chemistry</i>		
<b>Module №1. Theoretical foundations of inorganic chemistry. The Main Laws of chemical transformations</b>		
1.1	The main classes of inorganic substances	4
1.2	Control Test "Classification of Inorganic Substances"	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	2
1.6	Control Test "Theory of electrolytic dissociation"	2
<b>Module №2. Chemical transformations with change of oxidation number of elements or their valence</b>		
2.1	Ionic product of water. Hydrolysis of salts	4
2.2	Control Test "Hydrolysis of Salts"	2
2.3	Oxidation-reduction reactions	8
2.4	Control Test "RedOx reactions with products"	2
2.5	Control Test "RedOx reactions without products"	2
2.6	Complex (coordination) compounds	4
2.7	Control test "Complex (coordination) compounds"	2
<b>Total hours from the section "Inorganic chemistry": 38 hours.</b>		
<i>Analytical chemistry</i>		
<b>Module №3. Principles and methods of Qualitative Analysis of Cations and Anions</b>		
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
<b>Module №4. Theoretical and experimental foundations of Quantitative chemical analysis. Gravimetry and neutralization method. Red Ox methods and complexing methods</b>		
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
<i>Total hours from the section "Analytical chemistry": 37 hours.</i>		
<b>Total lab hours:</b>		<b>75 hours.</b>

#### 4. Topics for self-study

№ s/n	Topic title	Hours
1	Basic concepts of chemistry. Classification of inorganic substances	20
2	Chemical transformations metals and non-metals	20
3	Analysis of unknown substances	19
4	Solutions. Methods of expressing the concentration of solutions	16

#### 5. Tools for assessing expected learning outcomes:

(select necessary or add)

- exam;
- module tests;
- abstracts;
- graphic design works;
- laboratory works performing
- presentation of laboratory and practical works; - other types.

#### 6. Teaching methods:

- verbal method (lecture, discussion, interview, etc.);
- practical method (laboratory, practical classes);
- visual method (illustration, demonstration);
- processing learning resources (note-taking, summarising, reviewing, writing an abstract);
- video method (remote, multimedia, web-based, etc.);
- self-study (completing assignments); - individual research work; - other types.

#### 7. Assessment methods:

- exam;

- credit;
- oral or written assessment;
- module tests;
- team projects;
- essays and reports;
- presentation of laboratory and practical works; - presentations at academic events - other types.

## 8. Distribution of points received by students

The assessment of students' knowledge and skills is conducted by means of a 100-point scale and is converted into national grades according to Table 1 of the current *Exam and Credit Regulations at NULES of Ukraine*.

Student's rating, points	National grading of exams and credits	
	exams	credits
90-100	excellent	pass
74-89	good	
60-73	satisfactorily	
0-59	unsatisfactorily	fail

To determine a student's rating in the discipline  $R_{DIS}$  (up to 100 points), the received assessment rating  $R_A$  (up to 30 points) is added to the academic performance rating  $R_{AP}$  (up to 70 points):  $R_{DIS} = R_{AP} + R_A$ .

## 9. Teaching and learning aids

- e-learning course of the discipline (<https://elearn.nubip.edu.ua/course/view.php?id=2471>);
- lectures and presentations (in electronic form);
- textbooks, manuals, tutorials;
- guidelines for studying a discipline by full-time and part-time students;.

## 10. Recommended sources of information

### Technology and methodological requirements

1. Methodological guidelines "Inorganic and analytical chemistry for bachelor students specialty 201 – "Agronomy". Voitenko L.V., Kopilevich V.A.,

Prokopchuk N.M. Savchenko D.A., Kravchenko O.O. – Kyiv: Експо-Друк., 2022. - 219 p.

2. Laboratory manual on Inorganic and Analytical Chemistry. Savchenko D.A., Voytenko L.V., Prokopchuk N.M.- Kyiv: Експо-Друк., 2017. - 216 p.

### **Required and recommended literature**

1. 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, 2019. — 456 p.
2. Introduction in General, Organic and Biochemistry, 7<sup>th</sup> Edition, by Morris Hein, Leo R. Best, Scott Pattison and Susan Arena, Brooks/Cole Publishing Co., 2021, 872 pp.
3. Inorganic Chemistry, second edition, D. F. Shriver, P. W. Atkins, and C.H. Langford; W. H. Freeman and Co., New York, 2004, 913 pp.

### **Supplemental**

1. Concepts and Models of Inorganic Chemistry, third edition, B. E. Douglas, D. H. McDaniel and J. J. Alexander; John Wiley & Sons, Inc., New York, 2014. 993 p.
2. Inorganic Chemistry, A Modern Introduction, T. Moeller; John Wiley & Sons, New York, 2008. 846 p.
3. Chemistry of the Elements, N. N. Greenwood and A. Earnshaw; Pergamon Press, New York, 2004. 1542 pp.

### **IT resources**

1. Introduction to inorganic chemistry: <https://bit.ly/3IAEddt> ;
2. Khan Academy about Chemical Reactions: <https://bit.ly/3IDtn6u>
3. Analytical chemistry. Laboratory Manual: <https://bit.ly/3KHh63A>
4. Virtual lab for Chemistry <https://chemcollective.org/vlabs>
5. Periodic Videos by Tedex platform <https://ed.ted.com/periodic-videos>
6. Modern dynamic Periodic Table of Elements <http://bit.ly/3Z56Bf5> 7. Global Fertilizer impact monitor <http://bit.ly/3Z50IDS>