



## SYLLABUS OF AN ACADEMIC DISCIPLINE

### “Chemistry (Inorganic and Analytical)”

Academic Degree – Bachelor’s

Specialty 101 Ecology

Educational program -

Year of study – the first; Semester: 1

Form of study – full-time

Number of ECTS credits - 5

Language of instruction - English

Lecturer of the discipline

Lecturer’s contact

information (e-mail)

URL of the e-Learning course  
on the NULES e-learning  
portal

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<https://elearn.nubip.edu.ua/course/view.php?id=4107>

### ACADEMIC DISCIPLINE DESCRIPTION

**Inorganic chemistry** studies the theoretical foundations of the modern inorganic chemistry, including the chemical properties and transformations of macronutrients, micronutrients, toxic elements and their compounds. Chemical properties are described in terms of atomic-molecular studies, acid-base chemistry, redox processes and complexation. The laboratory course involves the preparation and study of a number of types of inorganic and complex compounds.

**Analytical chemistry (chemical analysis)** is the area of chemistry responsible for characterizing the composition of matter, both qualitatively (what is present) and quantitatively (how much is present). Course includes: (1) the qualitative tests of cations and anions; (2) methods of identification of soluble and insoluble substances; (3) gravimetric analysis; (4) volumetry (neutralization, RedOx methods, precipitation titrimetry; complexonometry).

#### Competences of the discipline:

Integral competency (IC): The ability to solve complex specialized problems and solve practical problems in the field of ecology, environmental protection, and sustainable environmental management, which involves the application of basic theories and methods of science about environments that are characterized by complexity and uncertainty of conditions.

General competences (GC):

GC1. Knowledge and understanding of the subject area and professional activity

GC8. Ability to conduct research at the appropriate level.

GC10. The ability to evaluate and ensure the quality of performed works.

Professional (special) competences (PC):

PC2. Ability to critically understanding and basic theories, methods and principles of natural sciences.

PC3. Ability to understand basic theoretical concepts regulations, concepts and principles of natural and of social and economic sciences.

PC7. Ability to monitor and evaluate current condition of environment based on analytical monitoring data.

**Expected Learning Outcomes (ELO):**

ELO3. Understand the basic concepts, theoretical and practical problems in the field of natural sciences, which are necessary for analysis and decision-making in the field of ecology, environmental protection and balanced nature management.

ELO14. Be able to create texts, make presentations and messages for professional audiences and the general public with observance of professional integrity and impossibility plagiarism.

ELO18. Combine the skills of independent and team work to achieve results with an emphasis on professional integrity and responsibility of or decision-making.

ELO19. Increase the professional level by continuing education and self-education.

ELO21. To be able to choose optimal methods and tools for research, collection and data processing.

### ACADEMIC DISCIPLINE STRUCTURE

Topic	Hours (lecture/lab)	Learning outcomes	Tasks	Assessment
<b>1 semester</b>				
<b>Module 1. Theoretical Foundations of the Inorganic Chemistry. The General Laws of Chemical Transformations</b>				
<b>Topic 1</b> .Chemistry as the science that deals with the properties, composition, and structure of substances	2/2	<b>Know</b> and understand the subject area and professional activity; <b>Be able to work and analyze</b> scientific and educational literature on the subject; <b>Gain practical skills and be able</b> monitor and evaluate current condition of environment based on chemical concepts. <b>To apply</b> the stoichiometric calculations for analysis and decision-making in the field of ecology, environmental protection and balanced nature management	Introduction test	10
<b>Topic 2.</b> Atomic structure of chemical elements	2/2		Etern testing	20
<b>Topic 3.</b> Periodicity of changes in structure and properties of elements and their compounds	2/2		Self-training test (Etern) Lab # 1 report. Properties of inorganic compounds	10 10
<b>Topic 4.</b> Chemical bonding and molecular structure	2/2		Module test	50
<b>Total for module 1</b>	<b>8/8</b>			<b>100</b>
<b>Module 2. The general laws of chemical transformations</b>				
<b>Topic 1.</b> Chemical kinetics and equilibrium	2/2	<b>To understand</b> basic theoretical concepts regulations, concepts and principles acid-base chemistry; chemical kinetics and equilibrium, theory of complex compounds for the analysis and decision-making in the field of ecology, environmental protection and balanced nature management. <b>To be able</b> to analyse the influence of acid-base processes on the water systems state; <b>To analyse</b> the acid-base equilibrium and complexing for monitoring and evaluate current condition of environment. <b>To apply</b> the concept of strong and weak electrolytes, complexing processes for the description of water ecosystems. <b>To calculate</b> the degree of electrolytic dissociation and a pH values. <b>To calculate</b> a RedOx potential in solutions.	Etern testing	10
<b>Topic 2.</b> Solutions and their properties. Electrolytes and electrolytic dissociation. Ionic equations.	3/3		Lab # 2 report. Acid-base chemistry: electrolytes and reactions in the solutions	10
<b>Topic 3.</b> Hydrolysis of salts. Notion of a pH	3/3		Lab # 3 report. Hydrolysis of salts	10
<b>Chapter 4.</b> RedOx processes	4/4		Lab # 4 report. RedOx processes	10
<b>Topic 5.</b> Complex (coordination) compounds	4/4		Lab # 5 report. Coordination compounds Module written work	10 50
<b>Total for module 2</b>	<b>16/16</b>			<b>100</b>
<b>Module 3. Chemistry of elements and qualitative chemical analysis</b>				
<b>Topic 1.</b> Subjects and objects of the chemical analysis (analytical chemistry). Methods of quantitative analysis. Subjects of qualitative and quantitative analyses. Methods of qualitative analysis. Analytical reactions and requirements to analytical reactions.	2/2	<b>To know</b> bases of qualitative analysis for its using of environmental monitoring. <b>To know how</b> to organize the working place and realize the lab techniques of semimicro qualitative tests. <b>To be able</b> to combine the skills of independent and team work to achieve results with an emphasis on professional integrity and responsibility of or decision-making. <b>To analyse</b> the advantages and disadvantages of the different analytical techniques; the importance of sensitivity and selectivity of analytical reactions	Lab # 6 report. Metal chemical-analytical properties	10
<b>Topic 2.</b> Chemical-analytical properties of	7/7		Lab # 7 report. Non-metal	10

the cations on the examples of s-elements belongs to IA and IIA groups, p- elements belongs to IIIA and IVA groups, and d-elements of the IIIB and VB groups.		separations and determinations of the cations and anions <b>To understand</b> the general principles of the creation for the experimental pathway of inorganic substances qualitative analysis; the importance of the chemical analysis in the environmental sciences and planning of the environment monitoring strategy.	chemical-analytical properties	
<b>Topic 3.</b> Chemical-analytical properties of the cations on the examples of p-elements belong to VIIA, VIA, VA, and IVA groups. Qualitative analysis of inorganic substances (salts, acids, bases, oxides).	7/7		Lab # 8 report. Qualitative analysis of inorganic substances Elern testing of self-work Module control test	20 10 50
<b>Total for module 3</b>	<b>16/16</b>			<b>100</b>
<b>Module 4. Theoretical and experimental foundations of the quantitative chemical analysis</b>				
<b>Topic 1.</b> Equilibrium in heterogeneous and homogeneous systems. Precipitation and sediment dissolving reactions; their application for qualitative and quantitative analysis	4/4	<b>To know</b> the content and math expression of the main units of concentrations; the idea of solubility predicting based of value of solubility product; the concept of a pH; ionic product of water; biological function depending pH; concept of a pH buffering; acid-basic indicators; the theory of volumetric quantitative methods (neutralization, RedOx, complexonometry) for using in monitoring and evaluation of current condition of environment based on analytical monitoring data.	Lab # 9 report. Gravimetric determination of Barium content in technical Barium salt	10
<b>Topic 2.</b> Theoretical foundations of measurement and processing of results in chemical analysis. The essence and task of quantitative measurements and calculations.	4/4	<b>To should be able to</b> transform units of concentrations; to measure a pH, to calculate the titration curves, to determine equivalent points, titration jump; to choice the acid-base indicators. <b>To analyse</b> quantitative calculations via units of concentrations using for environment evaluation.	Lab # 10 report. Neutralisation volumetry Lab # 11 Report. Permanganometric determination of Fe(II) concentration in solution	10 10
<b>Topic 3.</b> Titrimetric methods of quantitative analysis (volumetry). The application of volumetric methods in environmental analysis. Neutralization method.	4/4	<b>To understand</b> the application fields of the different units; the natural processes controlled by precipitation and dissolving of slightly soluble substances; the pathway of gravimetric and volumetric quantitative analyses; the features of above mentioned methods application in the environmental analyses.	Lab # 12 Report. Iodometric determination of Cu(II) content in solid salt	10
<b>Topic 4.</b> RedOxmetry in quantitative analysis.	4/4		Lab # 13 Report. Complexometric determination of Ca content in solution; total water hardness	10
<b>Topic 5.</b> Complexonometry in quantitative analysis.	4/4	<b>To have skills</b> in physical and precipitation Gravimetry; a pH calculations (e.g., strong acids and bases, weak acids and bases, hydrolysed salts; buffer solutions); to prepare buffer solutions.	Module control work	60
<b>Total for module 4</b>	<b>20/20</b>			<b>100</b>
<b>Total for 1<sup>st</sup> semester</b>	<b>60/60</b>			<b>70</b>
<b>Examination</b>				<b>30</b>
<b>Total for the course</b>				<b>100</b>

## ASSESSMENT POLICY

<b><i>Deadlines and exam retaking policy:</i></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><i>Academic integrity policy:</i></b>	Cheating during tests and exams is prohibited (including using mobile devices). Term papers and essays must have correct references to the literature used
<b><i>Attendance policy:</i></b>	Attendance is compulsory. For good reasons (e.g. illness, international internship), training can take place individually (online by the faculty dean's consent)

### SCALE FOR ASSESSING STUDENTS 'KNOWLEDGE AND SKILLS

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

### RECOMMENDED SOURCES OF INFORMATION

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.
3. Неорганічна та аналітична хімія: підручник / В.А. Копілевич, Д.А. Савченко, Т.І.Ущипівська. К.: Редакційно-видавничий відділ НУБіП України. 2020. 596 с.
4. Неорганічна та аналітична хімія: навчальний посібник у формі лабораторного практикуму Д.А. Савченко, В.А. Копілевич, Т.І.Ущипівська, Н.М. Прокопчук. К.: ДДП «Експо-Друк». 2021. 329 с.
5. 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.