



**COURSE SYLLABUS**  
**"INORGANIC AND ANALYTICAL CHEMISTRY"**  
**Degree of higher education - Bachelors**  
**Specialization 162 - „Biotechnology and**  
**bioengineering,,**  
**Educational programme,,Biotechnology and**  
**bioengineering,,**  
**Academic year 1 semester 2**  
**Form of study full-time (full-time)**  
**Number of ECTS credits 5**  
**Language of instruction English**

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**Lecturer of the  
course**  
**Contact information  
of the lecturer (e-  
mail)**

**Ph. D. Lavrik**  
**Ruslan**

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**Course page on  
eLearn**

<https://elearn.nubip.edu.ua/course/view.php?id=1201>

## **COURSE DESCRIPTION**

The natural sciences fall into two general categories – the biological sciences and the physical ones. The biological sciences are concerned primarily with the living things, and the physical sciences are concerned primarily with nonliving things, including rocks, the stars, electricity, the weather, energy from the sun, and the composition of all materials. Chemistry is a physical science.

In general, chemistry is the study of the composition, structure, and the properties of substances and the changes they undergo. This definition may suggest to you that chemistry has little to do with everyday life. This is not true. Your way of life would be radically different without the practical applications of chemistry. Imagine a supermarket offering only fruits and vegetables grown without manufactured fertilizers and pesticides. The quantities and varieties offered would be far fewer. Imagine drinking water from your tap that had not been purified. The unpurified water would probably

make you sick. Try to imagine a world without gasoline or heating oil. It would be very different from the world we live in.

Chemistry is a very broad subject. Most chemists would describe themselves as working in one of the following major areas of the science:

*Analytical chemistry* – the identification of substances and the qualitative and quantitative determination of the composition of materials.

A relative new direction of inorganic chemistry is *Bioinorganic chemistry*. Advances in bioinorganic chemistry since the 1970s have been driven by three factors: rapid determination of high-resolution structures of proteins and other bio-molecules, utilization of powerful spectroscopic tools for studies of both structures and dynamics, and the widespread use of macromolecular engineering to create new biologically relevant structures. Today, very large molecules can be manipulated at will, with the result that certain proteins and nucleic acids themselves have become versatile model systems for elucidating biological function.

Oxidation-reduction processes continue to be a central theme of biological inorganic chemistry. Well over half of the papers in this special feature deal with biological red-ox reactions in one way or another.

So, to study a course of bioinorganic chemistry is to understand the basic principles of acid-base processes, reactions in the water medium (dissociation, hydrolysis), red-ox reactions, complexing reactions and so on.

- **Competencies of the educational programme:**
- *Integrative competency (IC):*The ability to solve complex specialized problems and practical problems characterized by complexity and uncertainty in biotechnology and bioengineering, or in the learning process, which involves the application of theories and methods of biotechnology and bioengineering. \_\_\_\_\_
- **General competencies (GC):**
- GC1. Ability to apply knowledge in practical situations;
- GC03. Ability to communicate in a foreign language;
- GC05. Ability to learn and master modern knowledge;
- GC09. The ability to preserve and multiply moral, cultural, scientific values and achievements of society based on an understanding of the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society,

technology and technologies, to use various types and forms of motor activity for active recreation and leading a healthy lifestyle

- **Professional (special) competencies (SC):**\_\_

SC11. Ability to use a thorough knowledge of chemistry and biology to the extent necessary to achieve other outcomes of the educational program.

- **Program learning outcomes (ELO) of the educational programme:**

ELO2. Be able to carry out qualitative and quantitative analysis of substances of inorganic, organic and biological origin, using appropriate methods;

ELO12. Using microbiological, chemical, physical, physicochemical and biochemical methods, be able to carry out chemical control (determining the concentration of solutions of disinfectants, titration agents, concentration of nutrient medium components, etc.);

ELO22. Be able to take into account social, ecological, ethical, economic aspects, labor and industrial safety requirements sanitation and fire safety during the formation of technical solutions. Be able to use different types and forms of motor activities for active recreation and healthy living way of life.

**Course structure**

Themes and modules to be covered	Number of hours													
	Full-time							partl-time						
	w.	s	including i					total	including					
			l	p	lab	ind	stw		l	p	lab	ind	stw.	
<b>Theme module 1. Theoretical foundations of inorganic chemistry. Basic laws of chemical transformations</b>														
Theme 1. Chemistry as a component of natural scientific disciplines	1	8	2		4		2							
Theme 2. Structure of atoms of chemical elements	2	8	2		4		2							
Theme 3. The periodicity of changes in the	3	6	2		2		2							

Themes and modules to be covered	Number of hours													
	Full-time							partl-time						
	w.	s	including i					total	including					
			l	p	lab	ind	stw		l	p	lab	ind	stw.	
structure and properties of elements and their compounds														
Theme 4. Chemical bond and structure of molecules	3	6	2		2		2							
<b>Total with mod. 1</b>	1-3	28	8		12		8	36						
<b>Theme module 2. Basic laws of chemical transformations</b>														
Theme 5. Chemical kinetics and equilibrium	4	4	2		1		1							
Theme 6. Solutions and their properties. Electrolyte solutions and electrolytic dissociation.	4	8	4		3		1							
Theme 7. Salt hydrolysis reactions	5	7	2		4		1							
Theme 8. Oxidation-reduction reactions	6-7	14	4		8		2							

Themes and modules to be covered	Number of hours													
	Full-time							partl-time						
	w.	s	including i					total	including					
			l	p	lab	ind	stw		l	p	lab	ind	stw.	
Theme 9. Complex (coordination) compounds	7	7	2		4		1							
<b>Total with mod. 1+2</b>	4- 7	40	14		20		6	34						
<b>Theme module 3. Chemistry of elements and qualitative analytical analysis</b>														
Theme 10. Subject, task, meaning of analytical chemistry. Analytical research technique in natural sciences.	8	5	2		2		1							
Theme 11. Chemical- analytical properties of cations on the example of s- elements of I-A and II-A groups, p-elements of III-A and IV-A groups and d-	8-9	17	4		10		3							

Themes and modules to be covered	Number of hours													
	Full-time							partl-time						
	w.	s	including i					total	including					
			l	p	lab	ind	stw		l	p	lab	ind	stw.	
elements of periods 4 and 5.														
Theme 12. Chemical-analytical properties of anions on the example of p-elements VII-A, VI-A, V-A and IV-A groups.  Qualitative analysis of an unknown substance (salt, acid, base, oxide).	10	13	3		8		3							
<b>Разом за змістовим мод. 3</b>	8-10	36	9		20		7	34						

Themes and modules to be covered	Number of hours													
	Full-time							partl-time						
	w.	s	including i					total	including					
			l	p	lab	ind	stw		l	p	lab	ind	stw.	
<b>Theme module 4. Theoretical and experimental foundations of quantitative chemical analysis</b>														
Theme 13. Equilibrium in heterogeneous and homogeneous systems. Reactions of precipitation and dissolution of sediments and their significance for analysis.	11	9	4		3		2							
Theme 14. Theoretical foundations of measurement and processing of results in chemical analysis. The essence and task of quantitative measurements and calculations	12	6	2		2		2							
Theme 15. The essence of equilibrium in titrimetry. The	13	12	4		6		2							

Themes and modules to be covered	Number of hours													
	Full-time							partl-time						
	w.	s	including i					total	including					
			l	p	lab	ind	stw		l	p	lab	ind	stw.	
practice of measuring by the method of neutralization.														
Theme 16. Measurement by redoxmetry methods.	14	10	2		6		2							
Theme 17. Measurement by the method of complexometry.	15	9	2		6		1							
<b>Total with mod. 1+2+3+4</b>	12-15	46	14		23		9	46						
<b>total</b>	<b>1-15</b>	<b>150</b>	<b>45</b>		<b>75</b>		<b>30</b>	<b>150</b>						

### ASSESSMENT POLICY

<b><i>Policy regarding deadlines and resits:</i></b>	Assignments submitted after the deadline without valid reasons will be graded lower. Resitting of modules will be allowed with the permission from the lecturer and in the presence of valid reasons (e.g. medical reasons).
<b><i>Academic honesty policy:</i></b>	Cheating during tests and exams is strictly prohibited (including the use of mobile devices). Coursework and research papers must contain correct citations for all sources used.



<b>Attendance policy:</b>	Class attendance is mandatory. In case of objective reasons (such as illness or international internships), individual learning may be allowed (in online format by the approval of the dean of the faculty).
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### SCALE OF ASSESSMENT OF STUDENT KNOWLEDGE

National grade	Grade according to national system	Percentage score
passed	Excellent	90 – 100
	Very good	82-89
	Good	74-81
	Satisfactory	64-73
	Satisfactory enough	60-63
Not-passed	Unsatisfactory	35-59
	Unsatisfactory– serious work is needed	0-34

### Technology and methodological requirements

1. Voytenko L., Kopilevich V., Prokopchuk. Inorganic Chemistry. Manual. N. - Kyiv: NUBiP of Ukraine., 2019. - 148 p.
2. Voytenko L., Kopilevich V., Prokopchuk N. Workbook on Inorganic Chemistry. - Kyiv: NUBiP of Ukraine., 2019. - 85 p.
3. Voytenko L., Kopilevich V., Prokopchuk N. Laboratory manual on general and inorganic chemistry for bachelors students specialty 162 – “Biotechnology and bioengineering - Kyiv: NUBiP of Ukraine., 2024. - 203 p.
4. Lavrik R.V. Inorganic and analytical chemistry Inorganic Chemistry. <https://elearn.nubip.edu.ua/course/view.php?id=1201>

### Recommended sources of information

1. Morris Hein, Leo R. Best, Scott Pattison and Susan Arena. Introduction in General, Organic and Biochemistry, 7<sup>th</sup> Edition, by Brooks/Cole Publishing Co., 2020, 872 pp.

2. D. F. Shriver, P. W. Atkins, and C.H. Langford; W. H. Freeman. Inorganic and analytical Chemistry, second edition. New York, 2023, 913 pp.
3. <https://elearn.nubip.edu.ua/course/view.php?id=1185>