


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

Department of General, Organic and Physical Chemistry

“CONFIRMED”

Dean of the Design and Construction Faculty

Zinoviy RUZHYLO



“18” 05 2023

“APPROVED”

at the meeting of the department of

General, Organic and Physical chemistry

Protocol № 10 from 01. 05. 2023


Head of the Department

 Lidiya KOVSHUN

”REVIEWED ”

Program Coordinator

192 «Construction and civil engineering»

 Yevhen DMYTRENKO

PROGRAM OF THE COURSE

“CHEMISTRY”

Specialization «Construction and civil engineering»

Educational program 192 «Construction and civil engineering»

Faculty (Institute) Design and Construction

Developers: Associate Professor, PhD Krotenko Victoria,

Associate Professor, PhD Roman ZHYLA

Kyiv – 2023

1. Description of the course

CHEMISTRY

Field of knowledge, direction, specialty, education and qualification level		
Educational degree	Bachelor	
Specialization	192 – Construction and Civil Engineering	
Educational program	educational and professional	
Characteristics of the course		
Type	Compulsory	
Total number of hours	120	
Number of ECTS credits	4	
Number of content modules	3	
Form of assessment	Exam	
Indicators of academic discipline for full-time and part-time forms of training course		
	Full-time	Part-time
Course (year of study)	2023	2023
Semester	1	1
Lecture classes	15 hours	4
Laboratory classes	30 hours	6
Self-study	75 hours	110
Individual assignments		
Number of weekly classroom hours for the full-time form of study	3 hours 7 hours	

2. Purpose, objectives, and competencies of the course

Purpose. Students explore the fundamental chemical principles and their applications to the properties and transformations of materials. The course provides an overview of the field of electrochemistry with a focus on the chemical aspects of the interfacial processes.

Objectives.

The main goals of the course are – to provide a solid foundation in the study of matter and its changes and to understand and apply basic chemistry concepts in branch engineering.

Learning outcomes of course is the student's ability as a future specialist:

- outlines the historical development of major principles, concepts and ideas in chemistry;
- describes applications of chemistry which affect society or the environment;
- explains trends and relationships between elements in terms of atomic structure, the periodic table and bonding;
- describes chemical changes in terms of energy inputs and outputs;
- compiles the different chemical reaction, describes factors that influence the type and rate of chemical reactions;
- relates the uses of carbon to the unique nature of carbon chemistry;
- applies simple electrochemical processes;

Acquisition of competencies:

Integrated competency (IC): The ability to solve complex specialized construction and civil engineering tasks in the learning process, which involves the application of a set of theories and methods for determining strength, stability, deformability, modeling, strengthening of building structures; further safe operation, reconstruction, construction and installation of buildings and engineering structures; application of automated design systems in the field of construction.

General competencies (GC):

GC 1 – Ability to abstract thinking, analysis and synthesis.

GC 2 – Knowledge and understanding of the subject area and professional activity.

GC 6 – Ability to search, process and analyze information from various sources

GC 7 – Interpersonal skills.

Professional (special) competences (PC):

PC1 – Ability to use conceptual scientific and practical knowledge of mathematics, chemistry and physics to solve complex problems practical problems in the field of construction and civil engineering.

Program learning outcomes (PLO):

PLO 1 – Apply basic theories, methods and principles mathematical, natural, socio-humanitarian and economic sciences, modern models, methods and software tools to support adoption

solutions for solving complex construction and civil engineering problems engineering.

3. Program and structure of the course

Structure of the course “Chemistry”

Names of content modules and topics	Number of hours													
	Full time form							Part-time form						
	week	total	included					total	including					
			l	p	lab	ind	self		l	p	lab	ind	self	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Content Module 1. The basics atomic-molecular theory of the matter structure														
Topic 1. The main concepts and laws of chemistry	1	10	1		2		7	9					9	
Topic 2. Atomic structure	1	11	1		2		8	11	1		1		9	
Topic 3. The periodic law and Mendeleev’s periodic table of chemical elements	3	8	1		0		7	9					9	
Topic 4. The chemical bond and the structure of molecules	3	11	1		2		8	11			1		10	
Total for content module 1	8	40	4		6		30	40	1		2		37	
Content Module 2. Basic patterns of chemical processe														
Topic 1. Thermodynamic laws of chemical transformations. Kinetics of chemical reactions	5	8	1		2		5	7					7	
Topic 2. Properties of solutions of electrolytes and non-electrolytes. Electrolytic dissociation	5	10	1		4		5	9	1		1		7	
Topic 3. The redox processes and their conditions	7	8	2		2		4	9	1		1		7	
Topic 4. Fundamentals of electrochemistry. Chemical current sources	9	7	1		2		4	7					7	
Topic 5. Electrolysis	9	7	1		2		4	7					7	

of melts and solutions of electrolytes as oxidation - reduction process													
Total for content module 2	4	40	6		12		22	39	2		2		35
Content Module 3. Chemistry of elements and compounds of elements that make up the basis of inorganic and organic building materials													
Topic 1. Properties of metals and their compounds in building materials.	11	11	1		4		6	9					9
Topic 2. Corrosion processes and materials protection against corrosion	11	11	1		4		6	10			1		10
Topic 3. Bases of organic chemical compounds.	13	9	2		2		5	11	1		1		9
Topic 4. Polymeric materials and their applications in engineering	15	9	1		2		6	10					10
Total for content module 3	3	40	5		12		23	41	1		2		38
Total hours	120		15		30		75	120	4		6		110
Course project (work) with			-	-	-		-						
Total hours	120		15		30		75	120	4		6		110

4. Laboratory class topics

№	Topic	Hours
1.	Introduction. Equipment and safety in chemical laboratory. Methods of chemical experiments.	2(0,5)
2.	Bases of modern nomenclature and classification of inorganic compounds.	2(0,5)
3.	The structure of the atom and Mendeleev's periodic law	2
4.	Determination of the types of chemical bonds between atoms in compounds. The relative electronegativity of atoms.	2(0,5)
5.	Determination of the thermal effect of the neutralization and dissolution of anhydrous salts.	2
6.	Calculation of kinetic parameters of the reaction according to the experiment.	2
7.	Determination of the conductivity of electrolyte solutions. Indicator method of pH solutions calculation.	2(0,5)
8.	The preparation of solutions given concentration	2(0,5)
9.	The properties of metals in redox reactions.	2(0,5)

10.	The dependence of electromotive force from galvanic cells of metals.	2(0,5)
11.	Investigation of electrolysis of aqueous solutions of electrolytes. The calculations of the amount of substances using Faraday's law.	2(0,5)
12.	Determination of corrosion mass index rate.	2(0,5)
13.	The chemical properties of metals and their compounds.	2(0,5)
14.	The genetic link between the classes of organic compounds, the methods of detection of organic compounds.	2(0,5)
15.	The properties of polymers. Introduction to methods of determining the quality of fuels.	2(0,5)

30hours (6 hours)

5. Independent work topics

№	Topic title	Number of hours
Content Module 1. The basics atomic-molecular theory of the matter structure		
1.	Structure of molecules and methods of their research	2
2.	The importance of chemistry for the modern national economy and ecology	2
3.	The main directions of chemicalization of the agro-industrial complex	2
4.	Crystallization as a purification method	2
5.	From the craft of chemistry to chemical technology	2
6.	Allotropic modifications of Oxygen	2
7.	Basic concepts of chemistry	2
8.	The wonderful world of diamonds	2
9.	The main minerals of Ukraine	2
10.	The effect of radiation on living organisms: norms, doses, protection, problems	2
11.	Chemical bond	1
12.	Chemistry and solution of raw material and energy deficit	2
13.	Agrochemistry is an interdisciplinary science.	1
14.	Biogeochemistry is a new branch of natural sciences	2
15.	Liquid crystals and their application prospects in industry	2
Content Module 2. Basic patterns of chemical processes		
1.	Chrome plating of metal structures	2
2.	Manganese-zinc galvanic elements	1
3.	Hydrogen energy. Application prospects	1
4.	Passivation of metals	1
5.	Prospects for the use of lithium-ion batteries	1
6.	Anti-corrosion coatings in construction.	1
7.	Catalytic and electrochemical processes	1

8.	Water. Water hardness	1
9.	Peculiarities of changes in the chemical composition of groundwater in the conditions of economic activity	2
10.	Study of physical and chemical properties of drinking water	2
11.	Hydrolysis of salts	1
12.	Lead-acid batteries. Possibilities of use	1
13.	Non-polar solvents in construction	2
14.	Refining of metals	2
15.	Galvanostegia	2
16.	Electroplating	2
17.	Protective anodizing	2
18.	Electrochemical painting of metal parts	2
Content Module 3. Chemistry of elements and compounds of elements that make up the basis of inorganic and organic building materials		
1.	Polymers in structural materials	1
2.	Composite materials and their significance for the national economy	1
3.	Important zinc compounds, structure and properties	1
4.	The importance of chemistry in the creation of new materials	1
5.	Copper and its alloys	1
6.	Deformable aluminum alloys	1
7.	The influence of technological additives on the structure and properties of rubber	1
8.	Properties and applications of chromium and its compounds	1
9.	Nanotechnology. Development prospects	1
10.	Tin, its compounds and applications	1
11.	Polymethyl methacrylate. Plexiglass	1
12.	Non-ferrous metals and alloys	1
13.	Ceramics	1
14.	What is better - polymer or metal?	1
15.	Nanowires and other materials in the nanoworld	1
16.	Natural polymers in structural materials	1
17.	Alternative energy, development and prospects of implementation	1
18.	Calcium bioelement	1
19.	Coal and its processing products	1
20.	Natural, associated petroleum gas. Their composition. Oil	1

6. Control questions, sets of tests to determine the level of students' assimilation of knowledge

1. The key role of the atomic structure in predicting the physical and chemical properties of elements and their compounds.

2. Types of chemical bond. Covalent bond and its properties: saturation, multiplicity, directionality in space, polarity. Ionic bond.
3. Hydrogen bond. The role of the hydrogen bond in life processes. Metallic bond and mechanism of its formation.
4. Aqueous solutions of electrolytes. Electrical conductivity of solutions. Theory of electrolytic dissociation of substances in solutions and melts. Strong and weak electrolytes. Ways of expressing the concentration of a solution.
5. Redox processes. Oxidizing and reducing properties of chemical elements and their compounds. The concept of the degree of oxidation, typical oxidizing agents and reducing agents. Rules for compiling equations of redox reactions. The importance of oxidation-reduction processes in nature, technologies for obtaining metals in the automotive industry.
6. Concept of electrode potential and its occurrence. Electrochemical series of voltages of metals. The main conclusions from a series of voltages. Galvanic elements.
7. Accumulators: acid and alkaline, their structure, principle of operation. Oxidation-reduction reactions occurring during charging and discharging of batteries. The importance of chemical sources of electrical energy.
8. Electrolysis and its essence. The sequence of ion discharge on the electrodes. Quantitative ratios during electrolysis. Faraday's laws. Practical application of electrolysis. Decorative and protective application of electrolysis.
9. General characteristics of corrosion processes. Chemical, electrochemical, radiation and biocorrosion. Classification of corrosion processes according to flow conditions and types of damage.
10. Methods of protecting agricultural machinery from corrosion. Incompatibility of metals in metal structures and microcircuits.
11. The position of metals in the Periodic Table of D.I. Mendeleev, general characteristics of metals. Features of the electronic structure of atoms. Physical properties of metals: electrical conductivity, thermal conductivity, plasticity.
12. Methods of obtaining metals and alloys, special properties of alloys: heat resistance, lightness, corrosion resistance, hardness, etc. The use of metal alloys and coatings in construction.
13. Theory of the chemical structure of organic compounds O.M. Butlerova. Classification, nomenclature and isomerism of organic compounds. Structure and properties of hydrocarbons. Oil and oil products. Products of oil processing.
14. Basic concepts of the chemistry of high molecular weight compounds: monomer, polymer, polycondensation, polymerization reaction. The main properties of high-molecular compounds: polyethylene, polystyrene, polyvinyl chloride, phenol-formaldehyde resins, etc. Application of polymer materials in construction.
15. Classification and nomenclature of inorganic compounds.
16. Amphotericity. Chemical properties of amphoteric compounds.
17. Chemical properties, classification and nomenclature of oxides.
18. Chemical properties, classification and nomenclature of hydroxides.
19. Chemical properties, classification and nomenclature of acids.

20. Chemical properties, classification and nomenclature of salts.
21. Degree of oxidation, its definition in compounds. Oxidation-reduction processes in galvanic cells and in processes of electrolysis of solutions and molten salts.
22. How to practically protect construction objects, structural materials from stray currents, communication networks at the bottom of reservoirs from corrosion.
23. Basic concepts of atomic-molecular theory: molecule, atom, chemical element, simple and complex substance, relative atomic and molecular masses, mole, molar mass. Law of conservation of mass of matter. The law of constancy of composition of chemical compounds. The law of multiple ratios. Law of equivalents. Avogadro's law.
24. Periodic law and periodic system of elements D.I. Mendeleev. Concept of groups, subgroups, periods, s-, p-, d-elements. Modern formulation of the periodic law. Basic regularities of the periodic system: changes in metallic and non-metallic, acid-base, oxidation-reduction properties of elements.
25. Concept of heterogeneous systems. Dispersed state of matter. General ideas about dispersed systems, colloidal solutions and their properties. Surface phenomena at the boundary of phase separation. Sorption processes. Dispersed systems in nature and in production.

8. Samples of control questions, tests for assessing the level of knowledge acquisition by students.

Module №1

«Atomic structure and chemical bond»

Variant № 1

1. The possible values of main(principal) quantum number are:

A.	integers from 0 to $n-1$;	B.	$+\frac{1}{2}$, $-\frac{1}{2}$;
C.	integers from 1 to ∞ ;	D.	integers from $+l$ to $-l$.

2. The total number of orbitals in an s-subshell is?..... :

(write right answer to the answer sheet)

3. Which electron configuration represents an atom Sb in the ground state:

A.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^2 5p^3$;	B.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 5s^2 5p^6 5d^{10}$;
C.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^8 5s^2 5p^5$;	D.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^{10} 5s^1 5p^4$

4. To give the characteristics of elements:

№ 17, № 50

Scheme of answer:

- To determine (according to the placement of element in the periodic system):
 - element properties - metal or non-metal;
 - the total number of electrons, the total number of shells, the total number of valence electrons;
 - To compile electronic and graphic structure of atom of elements.
 - To determine the possible valence and oxidation number of element.
 - To give an examples of compounds (oxides, bases, acids, salts) with all of possible oxidation numbers.
 - To confirm chemical properties with the proper chemical equations.
5. To compile equation between simple substances formed by elements with atomic number 30 and 8, specify the type of chemical bond of obtained compound

6. Determine the types of chemical bonds for the following compounds:

manganese; potassium carbonate; phosphate acid; calcium hydroxide; ferrum (III) sulfate

Variant № 2

1. What's formula determine value of secondary (azimunthal) quantum number:

A.	$2l + 1$;	B.	$2n^2$;	C.	$2(2l + 1)$;	D.	$0 \div n-1$.
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2. Electronic structure of atom Manganese :

(write right answer to the answer sheet)

3. The total number of shells (levels) of atom is equal to the number of..:

A.	Group ;	B.	Element;
C	Period;	D	Series.

4. To give the characteristics of elements:

№ 15, № 40

Scheme of answer:

- To determine (according to the placement of element in the periodic system):
- element properties - metal or non-metal;
- the total number of electrons, the total number of shells, the total number of valence electrons;
- To compile electronic and graphic structure of atom of element.
- To determine the possible valence and oxidation number of element.
- ☐ To give an examples of compounds (oxides, bases, acids, salts) with all of possible oxidation numbers.
- To confirm chemical properties with the proper chemical equations.

5. To compile equation between simple substances formed by elements with atomic number 16 and 19, specify the type of chemical bond of obtained compound

6. Determine the types of chemical bonds for the following compounds:

steel; chrome (III) nitrate; silicate acid; carbon (IV) oxide; chlorine

Variant № 3

1. The total number of orbitals in an f-subshell is:

A.	7;	B.	3;	C.	5;	D.	1.
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2. The orientation of an orbital in space is specified by quantum number:

(write only one word to the answer sheet)

3. Which electron configuration represents an atom Zr in the ground state:

A.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 5s^2 5p^2$;	B.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^8 4s^2 4p^6 5s^2 5p^4$;
Б.	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^2 5s^2$;	Г	$1s^2 2s^2 2p^6 3s^2 3p^6 3d^{10} 4s^2 4p^6 4d^3 5s^1$

4. To give the characteristics of elements:

№ 7, № 23

Scheme of answer:

- To determine (according to the placement of element in the periodic system):
- element properties - metal or non-metal;
- the total number of electrons, the total number of shells, the total number of valence electrons;
- To compile electronic and graphic structure of atom of element.
- To determine the possible valence and oxidation number of element.
- ☐ To give an examples of compounds (oxides, bases, acids, salts) with all of possible oxidation numbers.
- To confirm chemical properties with the proper chemical equations.

5. To compile equation between simple substances formed by elements with atomic number 7 and 8, specify the type of chemical bond of obtained compound

6. Determine the types of chemical bonds for the following compounds:

barium chlorate; potassium carbonate; 2 molecule of fluoride acid; zinc hydroxide; scandium

Module №2

«The bases of electrochemistry»

Variant № 1

- Specify the number of lost or attached electrons according to the scheme
 $\text{HNO}_3 \rightarrow \text{NH}_3$:
 A. +2, B. -2, C. -3, D. +8.
- To write molecular, complete and net ionic equations:
 $\text{ZnCl}_2 + \text{K}_3\text{PO}_4 \rightarrow$ $\text{Ba}(\text{NO}_3)_2 + \text{H}_2\text{SO}_4 \rightarrow$
 $\text{K}_2\text{SiO}_3 + \text{HCl} \rightarrow$ $\text{Fe}_2\text{O}_3 + \text{HNO}_3 \rightarrow$
 $\text{Zn}(\text{OH})_2 + \text{Ca}(\text{OH})_2 \rightarrow$ $(\text{NH}_4)_2\text{SO}_4 + \text{NaOH} \rightarrow$
 $\text{Ba} + \text{H}_2\text{SO}_4 \text{ conc.} \rightarrow$ $\text{Mn} + \text{HNO}_3 \text{ dil.} \rightarrow$
 $\text{Cu} + \text{HCl} \rightarrow$ $\text{Na} + \text{H}_2\text{O} \rightarrow$
 $\text{Al} + \text{NaOH} \rightarrow$ $\text{Zn}(\text{CH}_3\text{COO})_2 + \text{Mg} \rightarrow$
- To calculate EMF for the Fe-Cu galvanic cell:
 A. 1,92 V B. -1,92 V C. 2,8 V, V. -2,8 V
- Make the circuit electrode processes that occur on. cathode and anode during the electrolysis of aqueous solutions of potassium sulfate and melt sodium chloride?
- Calculate amount of Copper on the cathode during electrolysis of aqueous solution of nickel sulfate for 30 minutes at a current 2A??
 A. 71,6 g B. 4,12 g, C. 2,38 g, D. 1,19 g.

Variant № 2

- Specify the number of lost or attached electrons according to the scheme
 $\text{HNO}_3 \rightarrow \text{HNO}_2$:
 A. +2, B. -2, C. +1, D. +8.
- To write molecular, complete and net ionic equations::
 $\text{CoCl}_2 + \text{Na}_3\text{PO}_4 \rightarrow$ $\text{BaCl}_2 + \text{H}_2\text{SO}_4 \rightarrow$
 $\text{K}_2\text{SO}_3 + \text{HNO}_3 \rightarrow$ $\text{NH}_4\text{NO}_3 + \text{NaOH} \rightarrow$
 $\text{Al}(\text{OH})_3 + \text{NaOH} \rightarrow$ $\text{Cr}_2\text{O}_3 + \text{HClO}_4 \rightarrow$
- To calculate EMF for the Zn-Cu galvanic cell:
 A. 0,1 V B. -0,78 V, C. 0,78 V, D. 1,1 V.
- Make the circuit electrode processes that occur on. cathode and anode during the electrolysis of aqueous solutions of plumbum nitrate and melt of potassium chloride?
- Calculate amount of Nickel on the cathode during electrolysis of aqueous solution of nickel sulfate for 80 minutes at a current 5A?
 A. 1,83g B. 14,7 g, C. 7,3 g, D. 2,23 g.

Module №3

« Chemistry of the elements»

Variant № 1

- To write the dissociation equation for the ions of the following compounds:
 ferrum (III) carbonate, itric acid, potassium hydroxide.
- Specify the number of lost or attached electrons according to the scheme
 $\text{NO}_3^- \rightarrow \text{NH}_3$:
 A. +2, B. -2, B. -3, Г. +8.
- Balance Redox reactions using method of electron balance. Point out oxidizing and reducing agents:
 $\text{Ba} + \text{H}_2\text{SO}_4 \text{ conc.} \rightarrow$ $\text{Mn} + \text{HNO}_3 \text{ dil.} \rightarrow$
 $\text{Cu} + \text{HCl} \rightarrow$ $\text{Na} + \text{H}_2\text{O} \rightarrow$
 $\text{Al} + \text{NaOH} \rightarrow$ $\text{Zn}(\text{CH}_3\text{COO})_2 + \text{Mg} \rightarrow$
- Determine reactions of oxygen depolarization of iron:

1. $\text{Fe} - 2 \bar{e} \rightarrow \text{Fe}^{2+};$	3. $1/2\text{O}_2 + \text{H}_2\text{O} + 2 \bar{e} \rightarrow 2\text{OH}^-;$
2. $\text{Fe}^{2+} + 2 \bar{e} \rightarrow \text{Fe};$	4. $2\text{H}^+ + 2 \bar{e} \rightarrow \text{H}_2.$

Variant № 2

- To write the dissociation equation for the ions of the following compounds:**
Aluminium hydroxide, manganese (II) chloride, sulfate acid.
- Specify the number of lost or attached electrons according to the scheme**
 $\text{NO}_3^- \rightarrow \text{NO}_2$:
A. +2, B. -2, C. +1, D. +8.
- Balance Redox reactions using method of electron balance. Point out oxidizing and reducing agents:**
 $\text{Ca} + \text{H}_2\text{SO}_4 \text{ conc.} \rightarrow$ $\text{Cu} + \text{HNO}_3 \text{ dil.} \rightarrow$
 $\text{Au} + \text{HCl} \rightarrow$ $\text{Ba} + \text{H}_2\text{O} \rightarrow$
 $\text{Cr} + \text{NaOH} \rightarrow$ $\text{Cu}(\text{CH}_3\text{COO})_2 + \text{Zn} \rightarrow$

4. Point the correspondence of the coating and processes:

A Non-damage	1. $(\text{C}) \text{Zn}^{2+} + 2 \bar{e} \rightarrow \text{Zn};$	3. $(\text{C}) \text{Fe}^{2+} + 2 \bar{e} \rightarrow \text{Fe};$
B damaged	2. $(\text{A}) \text{Fe} - 2 \bar{e} \rightarrow \text{Fe}^{2+};$	4. $(\text{A}) \text{Zn} - 2 \bar{e} \rightarrow \text{Zn}^{2+}.$

7. Teaching methods.

In conducting lectures appropriate to use verbal teaching methods: explanation, narration, discussion, educational debate, with a combination of visual learning methods: illustration, showing. In carrying out laboratory work should be used such as verbal learning method of instruction on the combination of visual learning methods of illustration and demonstration, the aspect of these studies is that they facilitate communication theory and practice. Laboratory work in the laboratory are equipped basic chemical and electrochemical equipments.

8. Forms of assessment

The main methods of control of knowledge and skills students have to study the subject "Remote sensing for land resources monitoring" are: oral examination, written and practical test, standardized control in the form of modular test papers, assessment for individual learning task, the final test. The total value of these methods is to make the best possible to ensure timely and comprehensive feedback between students and teachers, by which establishes how students perceive and learn the material. The purpose determines the choice of control methods, it should be borne in mind that these methods can be applied in all kinds of control - only complete applications allows regularly and objectively identify the dynamics of the formation of knowledge and skills of students. Each control method has its advantages and disadvantages, scope of application, none of them can not be the only one able to diagnose all aspects of the learning process. So: - to control the absorption of lectures: oral questioning, written modular test papers, current testing

score for an individual learning task, the final test. - for the monitoring and evaluation of laboratory work: practical test and evaluation of each laboratory work.

9. Distribution of grades received by students during study.

Distribution of grades received by students. Evaluation of student knowledge is carried out on a 100-point scale and is converted to national grades according to Table 1 "Regulations and Examinations and Credits at NULES of Ukraine" (order of implementation dated 03.03.2021, protocol №7)

Student rating, points	National grade based on exam results	
	Exams	Credits
90-100	Excellent	Passed
74-89	Good	
60-73	Satisfactory	
0-59	Unsatisfactory	Not passed

In order to determine the rating of a student (listener) in the discipline R_{dis} (up to 100 points), the rating from the exam R_{ex} (up to 30 points) is added to the rating of a student's academic work R_{aw} (up to 70 points): $R_{dis} = R_{aw} + R_{ex}$.

10. Educational and methodological support.

List of visual and other teaching and methodical aids, methodical materials.

№	Name	Quantity
1	2	4
1.	Slides (electronic form) for the lecture course	1 note
2.	Tutorial	Electronic version

11. Recommended sources of information

12. Basic literature

1. David R. Klein. Organic Chemistry, 4th (January 5, 2019) 1st edition. Wiley. – 1390p.
2. General and Inorganic Chemistry: Textbook / V. O. Kalibabchuk [et al.] ; ed. V. O. Kalibabchuk. – Kyiv : AUS Medicine Publishing, 2019. – 455 p.
3. Основи загальної та неорганічної хімії: навчальний посібник. Перевидання / Н. М. Антрапцева, О. Д. Кочкодан. - К. : ФОП Ямчинський О.В., 2020. - 331 с.
4. Органічна, біоорганічна, фізична і колоїдна хімія: навчальний посібник / В. В. Кротенко, Л. О. Ковшун ; Національний університет біоресурсів і природокористування України. - Перевидання. - К. : НУБіП України, 2022. - 425 с.
5. Антрапцева Н.М., Кравченко О.О., Солод Н.В. Chemistry. Methodological guidelines for laboratory practice execution for students speciality: 192 – Construction and Civil Engineering”. - Видавничий центр « Експо-Друк », 2022. – 160 с.
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13. IT resources

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6. <https://bioapi.lk/chemistry-resource-book-sinhala-bioapi/>
7. <http://simplescience.ru/video/about:chemistry/>
8. <http://chemistry-chemists.com/Video.html>
9. <https://www.youtube.com/c/Thoisoi/>
10. <https://www.youtube.com/c/ChemistryEasy/>
11. <http://simplescience.ru/video/about:chemistry/>
12. <http://chemistry-chemists.com/Video.html>
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