NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Department of General, Organic and Physical Chemistry

APPROVED
by the Dean of the faculty
of Design and Engineering
_____ Ivan ROGOVSKY
"_____" _____2026

APPROVED
at the meeting of the Department
General, Organic and Physical
Chemistry
Minutes No.11 of "13_"05.2026
Head of the Department
_____Andrii HALSTYAN

REVIEWED "
Guarantor of OP
Guarantor of OP "_Engineering"
_____ Volodymyr BULGAKOV

CURRICULUM OF ACADEMIC DISCIPLINE
_"CHEMISTRY"__

Area of knowledge G Engineering, manufacturing and construction
Specialty __G11 Engineering ____
Academic programme __ Engineering __
Faculty (Education and Research Institute)_ Construction and Civil Engineering __
Developed by: Associate Professor, PhD Victoria Krotenko,
Associate Professor, PhD Roman Zhyla

Kyiv – 2026

Description of the discipline __CHEMISTRY _

(up to 1,000 printed characters)

Chemistry is a fundamental discipline, which provides engineering students with a background in important concepts and principles of chemistry. Some of the most important objectives, though, are more globall in nature. Emphasis will be placed on those areas considered most relevant in a civil engineering context, and practical applications in construction and civil engineeringwill be examined. These goals deal with the overall relationship between chemistry (or science in general) and civil engineering rather than with the details of any particular chemical principle.

Area of knowledge, specialty, academic programme, academic degree		
Academic degree	*Bachelor*	
Specialty	*G19 – Engineering*	
Academic programme	*Engineering*	
Characteristics of the discipline		
Type	Compulsory	
Total number of hours	120	
Number of ECTS credits	4	
Number of modules	3	
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	2026	2026
Term	1	1
Lectures	30 hours	6
Practical classes and seminars	30 hours	6
Laboratory classes	60 hours	108
Self-study		
Number of hours per week for full-time students	4 hours 4 hours	

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

Aim 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.

Competences acquired:

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
sources
GC 7 – Interpersonal skills.

Professional (special) competences (SC):

SC1 – 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.

Expected learning outcomes (ELO):

ELO 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.

2. Programme and structure of the discipline

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	10,5	1		0,5		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	11,5	1		0,5		10
Total for content module 1	40		4		6		30	40	2		1		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	8,5	1		0,5		7
Topic 3. The redox processes and their conditions	7	8	2		2		4	8,5	1		0,5		7
Topic 4. Fundamentals of electrochemistry. Chemical current sources	9	7	1		2		4	8	0,5		0,5		7
Topic 5. Electrolysis of melts and solutions of electrolytes as oxidation - reduction process	9	7	1		2		4	8	0,5		0,5		7
Total for content module 2	40		6		12		22	40	3		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		1		4		6	6,5					9
Topic 2. Corrosion processes and materials protection against corrosion	11		1		4		6	7	0,5		0,5		10
Topic 3. Bases of organic chemical compounds.	13		2		2		5	8	0,5				9
Topic 4. Polymeric materials and their applications in engineering	15		1		2		6	8			0,5		10
Total for content module 3	40		5		12		23	40	1		1		38
Total hours	120		15		30		75	120	6		4		110
Course project (work) with			-	-	-		-						
Total hours	120		15		30		75	120	6		4		110

3. **Topics of lectures**

No.	Topic	Hours
1	The main concepts and laws of chemistry	1
2	Atomic structure	1
3	The periodic law and Mendeleev's periodic table of chemical elements	1

4	The chemical bond and the structure of molecules	1
5	Thermodynamic laws of chemical transformations. Kinetics of chemical reactions	1
6	Properties of solutions of electrolytes and non-electrolytes. Electrolytic dissociation	1
7	The redox processes and their conditions	2
8	Fundamentals of electrochemistry. Chemical current sources	1
9	Electrolysis of melts and solutions of electrolytes as oxidation - reduction process	1
10	Properties of metals and their compounds in building materials	1
11	Corrosion processes and materials protection against corrosion	1
12	Bases of organic chemical compounds	2
13	Polymeric materials and their applications in engineering	1

4. **Topic of laboratory (practical, seminars) classes**

No.	Topic	Hours
1.	Introduction. Equipment and safety in chemical laboratory. Methods of chemical experiments.	2
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
9.	The properties of metals in redox reactions.	2
10.	The dependence of electromotive force from galvanic cells of metals.	2
11.	Investigation of electrolysis of aqueous solutions of electrolytes. The calculations of the aount 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 og organic compounds.	1(0,5)
15.	The properties of polymers. Introduction to methods of determining the quality of fuels.	2(0,5)

5. **Topics of self-study**

No.	Topic	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 processe**		
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. Methods of assessing expected learning outcomes:

(select necessary or add)

- oral or written survey;
- interview;
- test;
- defending laboratory/practical, design/graphical works, projects;
- peer-to-peer assessment, self-assessment.

7. Teaching methods *(select necessary or add):*

- 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. **The basics atomic-molecular theory of the matter structure**		
Laboratory work 1. Introduction. Equipment and safety in chemical laboratory. Methods of chemical experiments.	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.	**15**
Laboratory work 2. Bases of modern nomenclature and classification of inorganic compounds		**15**
Laboratory work 3. The structure of the atom and Mendeleev's periodic law		**20**
Self-study *(if any)* 1.		**10**
Module control work 1.		**40**
Total for module 1		**100**
Module 2. **Basic patterns of chemical processe**		
Laboratory work 4. Determination of the	Apply basic theories, methods and principles	**10**

types of chemical bonds between atoms in compounds. The relative electronegativity of atoms	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.	
Laboratory work5. Determination of the thermal effect of the neutralization and dissolution of anhydrous salts		**10**
Laboratory work 6. Calculation of kinetic parameters of the reaction according to the experiment		**5**
Laboratory work 7. Determination of the conductivity of electrolyte solutions. Indicator method of pH solutions calculation		**10**
Laboratory work 8. The preparation of solutions given concentration		**10**
Laboratory work 9. The properties of metals in redox reactions		**5**
Self-study *(if any)* 1.		**10**
Module control work 2.		**40**
Total for module 2		**100**
Module 3. **Chemistry of elements and compounds of elements that make up the basis of inorganic and organic building materials**		
Laboratory work 10. The dependence of electromotive force from galvanic cells of metals	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.	**10**
Laboratory work 11. Investigation of electrolysis of aqueous solutions of electrolytes. The calculations of the aount of substances using Faraday's law		**5**
Laboratory work 12. Determination of corrosion mass index rate		**10**
Laboratory work 13. The chemical properties of metals and their compounds		**10**
Laboratory work 14. The genetic link between the classes of organic compounds, the methods of detection og organic compounds		**10**
Laboratory work 15. The properties of polymers. Introduction to methods of determining the quality of fuels		**5**
Self-study *(if any)* 3.		**10**
Module control work 3.		**40**
Total for module 3		**100**
Class work		**(M1 + M2+M3)/3*0,7 ≤ 70**
Exam/credit		**30**
Total for year		**(Class work + exam) ≤ 100**
Course project/work (*if any*)		**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	*EXAMPLE:* 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	*EXAMPLE:* cheating during tests and exams is prohibited (including using mobile devices). Term papers and essays must have correct references to the literature used
Attendance rules	*EXAMPLE:* 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:**

- e-learning course of the discipline (**https://elearn.nubip.edu.ua/course/view.php?id=1339**) *MANDATORY*;
- references to digital educational resources;
- textbooks, manuals, tutorials;
- guidelines for studying a discipline by full-time and part-time students;
- internship programmes of the discipline (if included in the curriculum).

10. 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.
6. Антрапцева Н.М., Солод Н.В., Кравченко О.О. Chemistry. Methodical guidelines for the English-language course mastering for students of technical direction. - К.: Видавничий центр «»Експо-Друк, 2018. - 151 с.

7. Антрапцева Н.М., Жила Р.С. Хімія. Методичні вказівки з лабораторного практикуму для студентів спеціальності 192 – Будівництво та цивільна інженерія. Ступінь освіти «Бакалавр». К.: ДДП «Експо-Друк», 2022. 160 с.
8. Антрапцева Н.М., Кочкодан О.Д., Жила Р.С. Хімія. Тестові завдання для самостійної роботи студентів спеціальностей: 151 – Автоматизація та комп'ютерно-інтегровані технології, 133 – Галузеве машинобудування, 192 – Будівництво та цивільна інженерія. К.: НУБіП, 2019. – 160 с.

Supplemental materials

1. Arthur Winter. Organic Chemistry I For Dummies, 3nd Edition, 2019. – 384 p.
2. Хімія: навчальний посібник для студентів спеціальності 201 "Агрономія" скороченого терміну навчання / В. В. Кротенко, О. І. Хижан, Л. О. Ковшун ; Національний університет біоресурсів і природокористування України. - К. : НУБіП України, 2019. - 429 с.

13. IT resources

1. https://ptable.com/
2. https://learningapps.org/
3. https://chemequations.com/en/
4. https://learningcenter.unc.edu/services/stem/chemistry-resources/
5. https://edu.rsc.org/
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
13. http://www.chemicum.com/ru/
14. https://www.youtube.com/channel/UCD2fRmgV93G8ZUxZTGLbScA