



Migration of toxicants in the biosphere
Working program of the academic discipline (Syllabus)

Details of the academic discipline

| | |
|--|--|
| Level of higher education | First (Bachelor) |
| Branch of knowledge | <i>10 Natural Sciences</i> |
| Specialty | <i>101 Environmental Studies</i> |
| Educational program | <i>Environmental safety</i> |
| Discipline status | <i>Selective</i> |
| Form of education | <i>full-time (day)/distance/mixed</i> |
| Year of training, semester | <i>2nd year/4 semester</i> |
| Scope of the discipline | <i>4 ECTS credits (120 hours)</i> |
| Semester control/control measures | <i>Test</i> |
| Lessons schedule | <i>4 hours per week (2 hours of lectures and 2 hours of laboratory classes)</i> |
| Language of teaching | <i>Ukrainian</i> |
| Information about head of the course / teachers | Lecturer: https://eco-paper.kpi.ua/pro-kafedru/vykladachi/tverdokhlib-mariya-mikolajivna.html Laboratory: https://eco-paper.kpi.ua/pro-kafedru/vykladachi/tverdokhlib-mariya-mikolajivna.html |
| Placement of the course | https://do.ipk.kpi.ua/course/view.php?id=6400 |

Program of educational discipline

1. Description of the educational discipline, its purpose, subject of study and learning outcomes

The active influence of man on nature, the intensive use of natural resources by society, the process that is commonly called scientific and technical progress is selfish in its essence, since it is based on the principle: everything is for the good of man. At the same time, the environment was under such a load, which is constantly increasing. Currently, the load has already reached such a level that it calls into question the existence of the person himself.

Such a situation caused a rapid development of society's activities aimed at protecting the environment. One of the components of the strategy for improving the state of the environment is the study of the processes of migration and transformation in it of both pollutants and natural compounds. This knowledge makes it possible to establish the depth of self-purification processes of the biosphere for certain substances. And, accordingly, to make engineering decisions in the fields of production in the future.

***The subject of the educational discipline "Migration of toxicants in the biosphere"** – conditions of formation and distribution of chemical elements in the Earth's geospheres, patterns of their migration and mass exchange between living organisms and the environment.*

To successfully solve tasks in professional activities in the field of ecology, environmental protection and balanced nature management, specialists must have an understanding of the use of modern geochemical methods, geochemical features and regularities of the functioning of all geospheres and the biosphere.

The goal of the educational discipline "Migration of toxicants in the biosphere"

The purpose of the educational discipline is to strengthen the competences formed by students:

- Ability to critically understand basic theories, methods and principles of natural sciences;*
- Ability to conduct environmental monitoring and assess the current state of the environment;*

- The ability to apply modern methods and means of monitoring the state of atmospheric air, natural waters, soils and biota, to determine the level of contamination of natural and industrial materials with radioactive elements, to possess methods of assessing the impact of adverse factors on living organisms, to determine the adaptive capabilities of the human body in environmental conditions.

1.2. The main tasks of the academic discipline.

After mastering the academic discipline, students must demonstrate the following learning outcomes:

- Understand the main 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 optimal use of nature;

- To carry out an assessment of the state of the environment, to determine the level of the enterprise (production) impact on the environment, to determine the main polluters of the environment of this enterprise (production);

- Conduct laboratory research using modern devices, ensure sufficient measurement accuracy and reliability of the results, process the obtained results.

2. Pre-requisites and post-requisites of the discipline (place in the structural and logical scheme of training according to the relevant educational program)

Studying the discipline "**Migration of toxicants in the biosphere**" is based on the principles of integration of various knowledge acquired by students during the study of the following disciplines: "Chemistry with the basics of biogeochemistry", "Geodynamics of the ecological environment", "Biology", "Special sections of biogeochemistry", "General ecology", "Analytical chemistry".

Discipline "**Migration of toxicants in the biosphere**" provides the disciplines "Normalization of anthropogenic load on the environment", "Technoecology".

3. Content of the academic discipline

Chapter 1: Chemical elements in the components of the biosphere.

Topic 1. Biosphere: general concept, origin and structure.

Topic 2. Chemical elements as the basis of living and non-living nature.

Topic 3. Natural cycles of biophilic elements and substances.

Chapter 2: Distribution and migration of chemical elements.

Topic 4. Migration of elements in the natural environment.

Topic 5. Geochemical barriers to migration.

Chapter 3: Chemical composition of natural waters and factors determining it.

Topic 6. Forms of finding chemical elements in natural waters.

Topic 7. Equilibrium processes in the hydrosphere.

Topic 8. Man-made water pollution.

Chapter 4: The atmosphere, its role in the circulation of substances and energy in nature.

Topic 9. Chemical components of the atmosphere.

Topic 10. Oxidizing processes in the atmosphere.

Topic 11. Anthropogenic air pollution.

Chapter 5: Lithosphere and pedosphere as environments for the migration of chemical elements.

Topic 12. Elemental composition and chemistry of the lithosphere.

Topic 13. Pedosphere, the role of soils in the circulation of matter in nature.

Chapter 6: Functions of living matter in reproduction of natural properties of geospheres

Topic 14. The role of biota in the circulation of chemical elements in the biosphere.

Theme 15. Biogeochemical zoning.

Chapter 7: Distribution of hazardous chemicals in the environment.

Topic 16. Toxicants in the environment.

Topic 17. Pollution of the biosphere by superecotoxicants.

4. Educational materials and resources

Basic literature

1. Fedyshin B.M., Dorokhov V.I., Pavlyuk G.V. etc. *Environmental chemistry: Study guide* / Kherson: Oldi-plus, 2020. – 516 p.
2. Voytenko L. V. *Chemistry with the basics of biogeochemistry: Study guide* / K.: Naukova stolitsia, 2019. – 400 p.
3. Marchuk, G. P., Bila T. A. *Geochemistry of the environment: academic. manual* / Kherson: Oldi-plus, 2019. - 242 p.
4. Bogatyrenko V. A., Chornyi I. B., Nesterovsky V. A. *Chemistry of the Earth: A study guide* / K.: Kondor-Vydavnytstvo, 2015.– 568 p.
5. Mitryasova O. P.. *Chemistry with the basics of biogeochemistry: a study guide* / K.: Kondor Publishing House, 2016. – 384 p.
6. Myslyuk O.O. *Basics of chemical ecology: Education. village* / K.: Condor Publishing House, 2015. - 660 p.
7. Fedorova G.V. *Biogeochemistry: teaching. manual.* / Odesa: TPP, 2015. P.16-23. - 284 p.

Auxiliary

8. Khilchevskiy V.K., Zabokrytska M.R. *Chemical analysis and assessment of the quality of natural waters: academic. manual.* / Lutsk: Tower-Print, 2021. 76 p.
9. Trokhymchuk I.M., Plyuta N.V., Logvynenko I.P., Sachuk R.M. *Biotechnology with the basics of ecology: a study guide* / K.: "Condor" Publishing House, 2019. - 304 p.
10. Bardov V. G., Fedorenko V. I., Biletska E. M. and others. *Basics of ecology: Textbook* / Publisher: Nova kniga, 2013 - 424 p.
11. Shablii T.O., Krysenko A.D., Krysenko T.V., Serbina R.V. *Basics of biogeochemistry: Methodical instructions for performing laboratory work.* K.: IVC "Polytechnic Publishing House", 2003. - Part 1: Determination of the characteristics of the quality of natural waters. - 44 p.
12. Fedorova G.V. *Workshop on biogeochemistry for ecologists. Tutorial.* K.: "KNT", 2007. - 228 p.
13. Bedrii Y.I., Kanarskyi Yu. *Environmental ecology. Nature protection: Education. village* - K.: Condor, 2015. - 306 p.
14. Ninova T.S. *Analytical chemistry of the environment. Educational and methodological manual* / Cherkassy: Cherkassk. national Bohdan Khmelnytskyi University, 2014. – 178 p.

Information resources on the Internet

15. Interactive map of river pollution in Ukraine URL:<https://texty.org.ua/water/>
16. Interactive 3D map of the Earth's air pollution. URL:<https://www.igair.com/earth>
17. Project "World Air Quality Index" URL:<https://waqi.info/uk/>
18. Ministry of Environmental Protection and Natural Resources of Ukraine URL:<https://mepr.gov.ua/>
19. State Agency of Water Resources of Ukraine URL:<https://www.davr.gov.ua/>
20. National Library named after V.I. Vernadskyi. URL:www.nbu.gov.ua
21. Electronic archive of scientific and educational materials KPI named after Igor Sikorsky - ELAKPI URL:<https://ela.kpi.do>

Educational content

5. Methods of mastering an educational discipline (educational component)

Lecture classes

Lectures are aimed at:

- provision of modern, integral, interdependent knowledge in the discipline "Migration of toxicants in the biosphere", the level of which is determined by the target setting for each specific topic;
- ensuring creative work of students together with the teacher during the lecture;
- education of students' professional and business qualities and development of their independent creative thinking;
- forming the necessary interest in students and providing direction for independent work;
- definition at the current level of scientific development in the field of modern ideas about chemical and biological processes taking place in the environment;
- reflection of the methodical processing of the material (highlighting of the main provisions, conclusions, recommendations, their wording is clear and adequate);
- the use of visual materials for demonstration, combining them, if possible, with the demonstration of results and samples;
- teaching research materials in a clear and high-quality language with observance of structural and logical connections, clarification of all newly introduced terms and concepts;
- accessibility for perception by this audience.

| No. z/p | The name of the lecture topic and the list of main issues (list of didactic means, references to literature and tasks at the IWS) | Hours |
|------------|---|-------|
| 1 | <p>Biosphere: general concept, origin and structure. Characteristics of the biosphere. Overview of the Earth's geospheres. Energy of the biosphere. Literature: (2), (7). SRS - Scientific approaches to the study of the biosphere.</p> | 2 |
| 2 | <p>Chemical elements as the basis of living and non-living nature. The main theories of distribution of chemical elements in geospheres. The content of chemical elements in the Earth's geospheres. Review of known geochemical classifications of chemical elements. literature: (4), (7). SRS - Forms of finding chemical elements in the earth's crust and biosphere.</p> | 2 |
| 3 | <p>Natural cycles of biophilic elements and substances. Types and functioning of geochemical cycles. The great geological cycle. Small biological cycle. Biogeochemical cycles of the main biophilic elements. Water cycle in nature. Anthropogenic influence on the circulation of substances in the biosphere. Literature: (1), (2), (7). SRS - Concept of reserve and exchange funds of biogeochemical cycles.</p> | 2 |
| 4 | <p>Migration of elements in the natural environment. The concept of migration, its definition. Characteristics of migration. Types of migration and indicators of different types of migration. Man-made migration. Biogenic migration and biogenic accumulation of chemical elements. Literature: (1), (2), (3), (7). SRS - Evaluation of the migration ability of chemical elements.</p> | 2 |
| 5 | <p>Geochemical barriers to migration Classifications of geochemical barriers. The main indicators of geochemical barriers. Practical significance of geochemical barriers. Literature: (4), (6), (7), (13). SRS – Creation of man-made geochemical barriers.</p> | 2 |

| | | |
|----|---|---|
| 6 | <p>Forms of finding chemical elements in natural waters. The hydrosphere and its components. The composition of natural waters, forms of elements. Composition of ocean water. Formation of the chemical composition of land waters. Chemical composition of underground waters. Literature: (3), (8), (14). SRS – Natural and wastewater quality indicators.</p> | 2 |
| 7 | <p>Equilibrium processes in the hydrosphere. Carbonate-calcium balance and water pH. Redox buffering of natural water bodies. Dissolution processes of gases in natural waters. Indicators of aggressiveness and instability of natural waters. Literature: (4), (7), (8). SRS - Chemical and biochemical indicators of water composition.</p> | 2 |
| 8 | <p>Man-made water pollution. Inorganic and organic water pollutants. Water migration of substances. Assessment of water pollution. Literature: (6), (9), (10). SRS - Processes of self-purification of water.</p> | 2 |
| 9 | <p>Chemical components of the atmosphere. Structure and composition of the atmosphere. Chemical components of air and sources of their formation. Chemistry of atmospheric aerosols. Literature: (3), (7). SRS - Cosmic rays in the atmosphere. Solar radiation.</p> | 2 |
| 10 | <p>Oxidizing processes in the atmosphere. Mechanisms of formation and destruction of ozone. Nitrogen compounds in the atmosphere. Sulfur compounds and their oxidation in the atmosphere. Photochemical oxidation of methane in the atmosphere. Greenhouse phenomena in the atmosphere. Literature: (5), (7). SRS - Physico-chemical nature of photochemical smog.</p> | 2 |
| 11 | <p>Anthropogenic air pollution Ways of pollutants entering the atmosphere. Features of the migration of substances in the atmosphere. Dispersion of impurities in the atmosphere. Literature: (3), (10). SRS – Concept of background concentrations of substances in the air.</p> | 2 |
| 12 | <p>Elemental composition and chemistry of the lithosphere. Forms of existence of chemical elements in the earth's crust. Natural physical and chemical processes operating in the lithosphere. The main factors of rock transformation in the lithosphere. Literature: (3), (13). SRS - Geochemical role of water in the lithosphere.</p> | 2 |
| 13 | <p>Pedosphere, the role of soils in the circulation of matter in nature. Elemental composition as a chemical characteristic of soils. Soil organic matter. Nitrogen and phosphorus compounds in soils. Patterns of distribution of pollutants in soils. Literature: (3), (10), (14). SRS - Buffer properties of the soil.</p> | 2 |
| 14 | <p>The role of biota in the circulation of chemical elements in the biosphere. Living matter in the biosphere and its functions. The role of chemical elements in living organisms. Biogenic migration of substances. Types of biogenic metabolism. Intensity of biological absorption. Concentrator organisms. Literature: (2) (3), (7), (10). SRS - Forms of influence of organisms on the environment.</p> | 2 |

| | | |
|----|---|----|
| 15 | <p>Biogeochemical zoning. <i>Concept and principles of biogeochemical zoning. Biogeochemical provinces. Biogeochemical endemics. Interaction of chemical elements: synergism and antagonism.</i> <i>Literature: (1), (2), (7).</i> <i>SRS – Formation and characteristics of anthropogenic biogeochemical anomalies.</i></p> | 2 |
| 16 | <p>Toxicants in the environment. <i>The concept of toxicity of substances. Classification of toxicants. Heavy metals as super ecotoxicants. The main patterns of migration of heavy metals in the biosphere. Persistent organic pollutants.</i> <i>Literature: (1), (3), (10).</i> <i>SRS - Factors of toxicity of harmful substances.</i></p> | |
| 17 | <p>Pollution of the biosphere by toxicants. <i>The main routes of entry of toxicants into the biosphere. Man-made chemical anomalies. Changes and transformation of natural processes and components of nature by economic activity.</i> <i>Literature: (1), (3), (10).</i> <i>SRS - Nature of substances of global chemical pollution.</i></p> | 2 |
| 18 | Test | 2 |
| | Hours in general | 36 |

Laboratory classes

In the system of professional training of students, laboratory classes occupy 50% of the classroom load. As a supplement to the lecture course, they lay and form the basis of the bachelor's qualification in ecology. The purpose of laboratory classes is the development of students' experimental skills, a research approach to studying the subject, and consolidation of theoretical material.

| No. z/p | Title of laboratory work | Hours |
|---------|--|-------|
| 1 | Introductory lesson. Safety training. Selection, storage and transportation of samples for analysis. | 2 |
| 2 | Determination of the main physical properties of water. | 6 |
| 3 | Determination of the content of dry residue in natural water. | 6 |
| 4 | Determination of total and carbonate hardness of water. | 4 |
| 5 | Determination of permanganate oxidizability of natural waters. | 4 |
| 6 | Determination of phenol content in water. | 4 |
| 7 | Determination of the content of calcium and magnesium ions in aqueous and saline soil extracts. | 4 |
| 8 | Determination of nitrate content in the soil. | 4 |
| 9 | Modular control work. | 2 |
| | Hours in general | 36 |

Independent work of student

Independent work takes up 40% of the time of studying the credit module, including preparation for the credit. The main task of students' independent work is the mastery of scientific knowledge in areas that are not included in the list of lecture questions through personal search for information, formation of an active interest in a creative approach to educational work. In the process of independent work within the framework of the educational component, the student must learn to deeply analyze modern knowledge about the transformation of chemical compounds of natural and anthropogenic origin in environmental conditions.

| No. z/p | Title of the topic submitted for self-study | Number of hours of IWS |
|--|--|---------------------------------------|
| Chapter 1. Chemical elements in the components of the biosphere. | | |
| 1 | <p><i>Scientific approaches to the study of the biosphere. Literature: (2).</i></p> <p><i>Forms of finding chemical elements in the earth's crust and biosphere. Literature: (7).</i></p> <p><i>Concept of reserve and exchange funds of biogeochemical cycles. Literature: (2).</i></p> | 8 |
| Chapter 2: Distribution and migration of chemical elements. | | |
| 2 | <p><i>Evaluation of the migration ability of chemical elements. literature: (1), (3).</i></p> <p><i>Creation of technogenic geochemical barriers. Literature: (13).</i></p> | 4 |
| Chapter 3: Chemical composition of natural waters and factors determining it. | | |
| 3 | <p><i>Indicators of the quality of natural and waste water. Literature: (8), (14).</i></p> <p><i>Chemical and biochemical parameters of water composition. Literature: (8).</i></p> <p><i>Water self-purification processes. Literature: (6), (9).</i></p> | 8 |
| Chapter 4: The atmosphere, its role in the circulation of substances and energy in nature. | | |
| 4 | <p><i>Cosmic rays in the atmosphere. Solar radiation. Literature: (4).</i></p> <p><i>Physicochemical nature of photochemical smog. Literature: (4), (13).</i></p> <p><i>The concept of background concentrations of substances in the air. Literature: (13).</i></p> | 8 |
| Chapter 5: Lithosphere and pedosphere as environments for the migration of chemical elements. | | |
| 5 | <p><i>Geochemical role of water in the lithosphere. Literature: (13).</i></p> <p><i>Buffer properties of the soil. Literature: (3).</i></p> | 4 |
| Chapter 6: Functions of living matter in reproduction of natural properties of geospheres | | |
| 6 | <p><i>Forms of influence of organisms on the environment. Literature: (7).</i></p> <p><i>Formation and characteristics of anthropogenic biogeochemical anomalies. Biogeochemical endemics. Literature: (1).</i></p> | 4 |
| Chapter 7: Distribution of hazardous chemicals in the environment. | | |
| 7 | <p><i>Toxicity factors of harmful substances. Literature: (10).</i></p> <p><i>The nature of substances of global chemical pollution. Literature: (1).</i></p> | 2 |
| 8 | Preparation for the test | 5 |
| 9 | Preparation for MKR | 5 |
| Hours in general | | 48 |

Provision of program results by components of the educational component

| <i>The name is OK</i> | <i>Lecture classes</i> | <i>Practical and laboratory classes, individual assignments</i> |
|---|--|--|
| <p><i>Understand the main 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 optimal use of nature</i></p> | <p><u>Lecture 2.</u> Chemical elements as the basis of living and non-living nature. <u>Lecture 3.</u> Natural cycles of biophilic elements and substances. <u>Lecture 4.</u> Migration of elements in the natural environment. <u>Lecture 6.</u> Forms of finding chemical elements in natural waters. <u>Lecture 9.</u> Chemical components of the atmosphere. <u>Lecture 12.</u> Elemental composition and chemistry of the lithosphere. <u>Lecture 13.</u> Pedosphere, the role of soils in the circulation of substances in nature.</p> | |
| <p><i>Carry out an assessment of the state of the environment, determine the level of impact of the enterprise (production) on the environment, determine the main pollutants of the environment of this enterprise (production)</i></p> | <p><u>Lecture 8.</u> Man-made water pollution. <u>Lecture 11.</u> Anthropogenic air pollution. <u>Lecture 14.</u> The role of biota in the circulation of chemical elements in the biosphere. <u>Lecture 16.</u> Toxicants in the environment. <u>Lecture 17.</u> Pollution of the biosphere by toxicants.</p> | <p><u>Laboratory classes 2.</u> Determination of the main physical properties of water. <u>Laboratory classes 5.</u> Determination of permanganate oxidizability of natural waters. <u>Laboratory classes 6.</u> Determination of phenol content in water. <u>Laboratory classes 8.</u> Determination of nitrate content in the soil.</p> |
| <p><i>Conduct laboratory research using modern devices, ensure sufficient measurement accuracy and reliability of results, process the results obtained</i></p> | | <p><u>Laboratory classes 1.</u> Introductory lesson. Safety training. Selection, storage and transportation of samples for analysis. <u>Laboratory classes 3.</u> Determination of the content of dry residue in natural water. <u>Laboratory classes 4.</u> Determination of total and carbonate hardness of water. <u>Laboratory classes 7.</u> Determination of the content of calcium and magnesium ions in aqueous and saline soil extracts.</p> |

Policy and control

6. Policy of academic discipline (educational component)

Rules of attending classes and behavior in classes

Students are obliged to take an active part in the educational process, not to be late for classes and not miss them without a good reason, not to interfere with the teacher conducting classes, not to be distracted by activities unrelated to the educational process.

Rules for assigning incentive and penalty points

incentive points can be awarded by the teacher exclusively for the performance of creative works in the discipline or additional completion of online specialized courses with the receipt of the appropriate certificate:

- <https://www.coursary.com/course/water-quality-and-the-biogeochemical-engine-KZz04c8a?fromfld=lpads&req=wst&refsrc=qq>
- <https://ru.coursera.org/learn/global-warming>
- <https://ru.coursera.org/learn/chemicals-health>
- <https://www.edx.org/course/introduction-to-geochemistry>

But their sum cannot exceed 10% of the rating scale.

Penalty points are not provided within the academic discipline.

Policy of deadlines and rescheduling

In the event of arrears from the academic discipline or any force majeure circumstances, students should contact the teacher through the available (provided by the teacher) communication channels to resolve problematic issues and agree on the algorithm of actions for practice.

Policy of academic integrity

Plagiarism and other forms of dishonest work are unacceptable. Plagiarism refers to the absence of references when using printed and electronic materials, quotes, opinions of other authors. Inadmissible tips and write-offs during writing tests, conducting classes; passing a test for another student; copying materials protected by the copyright system without the permission of the author of the work.

The policy and principles of academic integrity are defined in Chapter 3 of the Code of Honor of the National Technical University of Ukraine "Ihor Sikorsky Kyiv Polytechnic Institute". More details: <https://kpi.ua/code>

Policy of academic behavior and ethics

Students should be tolerant, respect the opinions of others, formulate objections in the correct form, constructively support feedback during classes.

Standards of ethical behavior of students and employees are defined in Chapter 2 of the Code of Honor of the National Technical University of Ukraine "Ihor Sikorskyi Kyiv Polytechnic Institute". More details: <https://kpi.ua/code>

7. Types of control and rating system for evaluating learning outcomes (RSF)

Distribution of study time by types of classes and tasks in the discipline according to the working study plan:

| Semester | School time | | Distribution of training hours | | | | Control measures | | |
|----------|-------------|----------|--------------------------------|-----------|------------|-----|------------------|-----|------------------|
| | credits | acad. H. | Lecture | Practical | Lab. woks. | IWS | MCW | HCW | Semester control |
| 4 | 4 | 120 | 36 | - | 36 | 48 | 1 | -- | Test |

The student's credit module rating consists of the points he receives for:

1. modular control work (MCW is divided into 3 works),
2. work in 7 laboratory classes.

System of rating (weighted) points and evaluation criteria:

1. Modular control works.

The weighted point is 10. The maximum number of points for all test papers is equal to:

10 points x 3 works = 30 points

The task of the control work consists of test questions (20 units) for the corresponding sections of the syllabus of the credit module. Each test question is valued at 0.5 points.

2. Work in laboratory classes.

The weighted point is 10. The maximum number of points for all laboratory works is equal to: 10 points x 7 l/r = 70 points

Criteria for evaluating the performance of laboratory work

| Completeness and signs of task completion | Markets |
|--|---------|
| The work was completed in full without errors, the protocol was correctly drawn up with appropriate calculations and conclusions, the work was submitted to the defense in a timely manner. | 10 |
| The work was completed in full with minor errors or inaccuracies, in general, the protocol was correctly drawn up with appropriate calculations and conclusions, the work was submitted to the defense in a timely manner. | 8-9 |
| The work was completed in full with errors or inaccuracies in calculations, with vaguely formulated conclusions, the work was submitted for defense in a timely manner, | 7-5 |
| The work was not completed in full, there are no conclusions in the work, the work was submitted for defense late. | 1-4 |
| The work is not done. | 0 |

Thus, the rating scale for the discipline is:

$$R=10*3+10*7=100 \text{ points}$$

According to the results of educational work in the first 7 weeks, the "ideal student" should score 40 points. At the first certification (8th week), the student receives "credited" if his current rating is at least 20 points.

According to the results of educational work for 13 weeks of study, the "ideal student" should score 90 points. At the second certification (14th week), the student receives "credited" if his current rating is at least 45 points.

The maximum number of points is 100. To receive credit from the credit module "automatically" you need to have a rating of at least 60 points.

Students who at the end of the semester have a rating of less than 60 points, as well as those who want to improve their rating, take a credit control work (test). At the same time, the points received by the student during the semester are cancelled.

Each test question (100 units) is valued at 1 point.

Discipline rating scale

| Points | University scale |
|---|------------------|
| 95...100 points | Perfectly |
| 85...94 points | Very good |
| 75...84 points | well |
| 65...74 points | Satisfactory |
| 60...64 points | Enough |
| R<60 points | Disappointing |
| If $r_c < 20$ points or all laboratory work has not been passed | not allowed |

Work program of the discipline (syllabus):

Compiled senior lecturer, Ph.D., Tverdokhlib M. M.

Approved by the Department of E and TRP (protocol № 14 from 05/08/2023)

Approved by the Methodical commission of the faculty (protocol № 10 from 05/26/2023)