



Environmental Monitoring. Part 1. Environmental Monitoring

Work program of the discipline (Syllabus)

Details of the discipline

Level of higher education	<i>First (bachelor's)</i>
Field of knowledge	<i>10 Natural sciences</i>
Speciality	<i>101 Ecology</i>
Educational program	<i>Environmental safety</i>
Discipline status	<i>Required</i>
Form of study	<i>full-time (day)/remote/mixed</i>
Year of preparation, semester	<i>2nd year, spring semester</i>
Scope of discipline	<i>4 ECTS credits (120 hours)</i>
Semester control/ control measures	<i>Exam writing</i>
Schedule of classes	<i>3 hours per week (2 hours lectures, 1 hours practical classes)</i>
Language of instruction	<i>Ukrainian</i>
Information about the course / teachers	Lecturer: https://eco-paper.kpi.ua/pro-kafedru/vykladachi/vizytky/radovenchik-vyacheslav-mikhajlovich.html ; Practical /Laboratory: https://eco-paper.kpi.ua/pro-kafedru/vykladachi/vizytky/radovenchik-vyacheslav-mikhajlovich.html ;
Course placement	https://do.ipk.kpi.ua/course/view.php?id=2782

The program of the discipline

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

Violation of the stability of the system "man - nature - society" in modern conditions is due to the significant destructive influence of mankind on the state of the environment as a result of excessive growth of productive forces and quantitative growth of the population. All this led to a huge increase in the anthropogenic load on the Earth's ecosystems and almost to irreversible changes in the entire biosphere. The intensive development of scientific and technological progress has led to the emergence of a number of global environmental problems, each of which can lead to the destruction of our civilization. Among these problems, the most priority are: fresh water shortage, reduction of species biological and landscape diversity of the planet, greenhouse effect, ozone holes, acid rain, pollution of the oceans, desertification, death of forests, etc.

Reducing the level of anthropogenic impact on the biosphere can be achieved by qualitative management of socio-economic systems at all levels, ensuring their strategic orientation to the principles of sustainable (sustainable, harmonious) development (in the sense of sustainable development).

One of the main ways to implement the concept of sustainable development of society is the introduction at all organizational levels of a scientifically based system of environmental and socio-economic management, which would be based on objective data of the relevant system of environmental and socio-economic monitoring, which, in turn, it is the information basis of the concept of sustainable development and a kind of initial function of the management cycle.

Subject of the discipline "Environmental Monitoring. Part 1. Environmental Monitoring" The monitoring system should, in terms of information, ensure the organization of the necessary information flows and improve the observation of the main processes and phenomena in the biosphere. To make rational management decisions, a necessary condition is the availability of high-quality information support regarding the dynamics of various indicators that characterize the state of the environment. At the same time, all the negative trends occurring in the development of a complex system "man - nature - society" increase the relevance of both environmental and socio-economic monitoring.

The purpose of the discipline "Environmental Monitoring. Part 1. Environmental Monitoring" The purpose of studying this discipline is to form in the masters a set of knowledge in the field of modern technologies for measuring environmental parameters, the basics of standardization and certification in ecology, a set of skills and abilities necessary for the introduction into production and management of modern we and new methods and technologies for environmental protection, emission rationing, enterprise location planning and, in general, for the management of environmental activities.

In accordance with the goal, the preparation of masters in this speciality requires the forms of competences:

- The ability to assess the impact of technogenesis processes on the state of the environment and identify environmental risks associated with production activities. **C18.**

- The ability to conduct environmental monitoring and assess the current state of the environment. **C20.**

- The ability to apply up-to-date 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 master methods for assessing the impact of adverse factors on living organisms, to determine the adaptive capabilities of the human body in environmental conditions **C30.**

According to the requirements of the program of the discipline **"Environmental Monitoring. Part 1. Environmental Monitoring"**, after mastering it, students must demonstrate the following programmatic learning outcomes:

- To use the management principles on which the environmental safety system is based. **PO04.**

- Know the conceptual basis for monitoring and rationing anthropogenic load on the environment. **PO05.**

- Be able to predict the impact of technological processes and production on the environment. **PO11.**

- Participate in the development and implementation of projects aimed at optimal management and management of industrial and municipal waste. **PO12.**

- To carry out laboratory researches with use of modern devices, to provide sufficient accuracy of measurement and reliability of results, to process the obtained results. **PO26.**

2. Prerequisites and post-requisitions of disciplines (place in the structural and logical scheme of education according to the relevant educational program)

Study of the discipline **"Environmental Monitoring. Part 1. Environmental Monitoring"** is based on the study of the disciplines "Organic Chemistry", "Analytical Chemistry", "Geodynamics of the Ecological Environment". Discipline **"Environmental Monitoring. Part 1. Environmental Monitoring"** provides the study of the discipline "Rationing of anthropogenic load on the environment".

3. Contents

Section 1. General provisions.

Basic concepts, classification of environmental monitoring systems and historical aspects of the formation of the concept of "environmental monitoring". Stages of formation of environmental monitoring as a system. Factors that should be investigated in the monitoring system. Classification of

environmental monitoring systems. Approaches to the definition of environmental monitoring objects. Factors, indicators and indicators that are investigated in the environmental monitoring system. State Environmental Monitoring Program of Ukraine. Subjects of the state environmental monitoring system. Functioning of the state environmental monitoring system. Relations between the subjects of the state environmental monitoring system.

Section 2. Organization of monitoring of environmental components

Topic 2.1. Organization of monitoring of the state of atmospheric air

Pollution of atmospheric air. Categories, placement and number of observation posts. Program and methods of observation. Frequency and number of observations. Principles of selection of pollutants to control their content in the atmosphere. Atmospheric air sampling methods. Meteorological observations during air sampling. Conducting sub-phase observations. Collection and processing of chemical analysis results. Organization of continuous registration of air pollution.

Topic 2.2. Monitoring of surface waters of land

Sources and types of surface water pollution. Organization of a system for monitoring aquatic environments. Points of observation and control creations. Observation programs. Methods and terms of sampling. Hydrobiological observations of water quality and bottom sediments. Integral indicators for assessing water quality. Monitoring in the field of drinking water and drinking water supply.

Topic 2.3. Features of monitoring sea waters and ocean waters

Sources and types of pollution of the waters of the oceans and seas. Points and programs for monitoring marine pollution. Subjects and objects of monitoring of sea waters in Ukraine.

Topic 2.4. Monitoring of the geological environment

Features of the geological environment. Indicators of anthropogenic disturbance of the geological environment. General structure of monitoring of the geological environment. Methods of studying man-made changes in the geological environment. Stages of ecological and geological studies.

Topic 2.5. Features of the organization of soil monitoring

Feasibility study of soil monitoring. Sources and types of soil degradation. Indicators of man-made disturbance and soil pollution. Principles of organization of observations on the level of chemical pollution of soils. Organization of observations and control of soil pollution.

Section 3. Special types of environmental monitoring

Global environmental monitoring system. Features of the organization of background monitoring. Climate monitoring. Organization of radiation monitoring. Features of biotic monitoring. Ecological and hygienic monitoring. Monitoring of forest ecosystems. Agroecological monitoring. Socio-environmental monitoring. Features of public environmental monitoring.

4. Learning materials and resources

1. Basic

- 1. Environmental monitoring : textbook / [Bogolyubov V.M., Klimenko M.O., Mokin V.B., etc.]; edited by Prof. V.M. Bogolyubova. Ed. 2nd, revised and supplemented – Kyiv: NUBiPU, 2018. – 435 p.*
- 2. Environmental monitoring: textbook / [Bogolyubov V. M., Klymenko M. O., Mokin V. B. et al.] ; ed. A. M. Bogolyubov. [2-e ed., reworked. and extra.]. — Vinnytsia: VNTU, 2010. — 232 p.*
- 3. Klymenko M. O. Environmental monitoring: textbook / M. Klymenko O., Prischepa A. M., Voznyuk N. M. - K. : Academy, 2006. — 360 p.*
- 4. Krainyukov O. M. Environmental monitoring: textbook / O. M. Krainyukov. — Kharkiv : KhNU them. A. N. Karazin, 2009. – 176 p.*

2. Auxiliary

6. *Environmental monitoring: textbook – Vol. 1 / Zapolsky A.K., Voytsytskyi A.P., Pilkevych I.A. and others. – Kamyanets – Podilsky: PE "Medobory – 2006" – 408 p.*
7. *Environmental monitoring: textbook – Vol. 2 / Zapolsky A.K., Voytsytskyi A.P., Pilkevych I.A. and others. – Kamyanets – Podilsky: PE "Medobory – 2006". – 360 p.*
8. *Law of Ukraine "On Environmental Protection" of June 25, 1991, No. 1264-XII, as amended.*
9. *Regulations on the state environmental monitoring system (approved by the Cabinet of Ministers of Ukraine No. 391 of 30.03.98) // Official Bulletin of Ukraine dated 16.04.1998, No. 13, P.91.*
10. *Regulations on land monitoring (approved by the Cabinet of Ministers of Ukraine No. 661 of 20.08.93) // Collection of Resolutions of the Government of Ukraine. - 1994. - №1.*
11. *Radovenchyk, V. M., Radovenchyk, J. V., & Kachula, I. G. (2016). ACCESS TO ENVIRONMENTAL INFORMATION IN UKRAINE. Bulletin of NTUU "Igor Sikorsky KPI". Series: Chemical Engineering, Ecology and Resource Saving, (1), 75–81. <https://doi.org/10.20535/2306-1626.1.2016.77947>.*
12. *Radovenchyk, V. M., Ivanenko, O. I., Krysenko, T. V., & Radovenchyk, Y. V. (2022). Air quality monitoring systems in Kyiv. Bulletin of NTUU "Igor Sikorsky KPI". Series: Chemical Engineering, Ecology and Resource Saving, (1), 70–79. <https://doi.org/10.20535/2617-9741.1.2022.254161>.*

Information resources on the Internet

1. *Ministry of Environmental Protection and Natural Resources of Ukraine - <https://mepr.gov.ua/>*
2. *Industrial ecology. Community of environmental specialists - <http://www.eco.com.ua/>*
3. *Professional Association of Ecologists of Ukraine (PAEU) - <https://paeu.com.ua/>*
4. *State Statistics Service of Ukraine – <http://www.ukrstat.gov.ua/>*
5. *State Agency on Energy Efficiency and Energy Saving of Ukraine - <https://sae.gov.ua/uk/ae>.*
6. *State Service of Ukraine on Food Safety and Consumer Protection – <https://dpss.gov.ua/>*

Educational content

5. Methods of mastering the discipline (educational component)

Lectures

Lectures are aimed at:

- *providing modern, holistic, interdependent knowledge in the discipline "Environmental Monitoring. Part 1. Environmental Monitoring", the level of which is determined by the target setting for each specific topic;*
- *ensuring in the process of the lecture the creative work of students together with the teacher;*
- *education of students' professional and business qualities and the development of their independent creative thinking;*
- *formation of students' necessary interest and providing direction for independent work;*
- *determining the current level of development of science in the field of measuring parameters and assessing the state of the environment, forecasting its development for the coming years;*
- *reflection of the methodological processing of the material (selection of the main provisions, conclusions, recommendations, clear and adequate to their formulations);*
- *use for demonstration of visual materials, combination, if possible, them with a demonstration of results and samples;*
- *teaching materials in a clear and high-quality language in compliance with structural and logical connections, explaining all newly introduced terms and concepts;*
- *accessibility for perception by this audience.*
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No s/n	The title of the lecture topic and the list of main issues (list of didactic tools, references to literature and tasks for the IWS)	Hours
1	<u>Basic concepts, classification of environmental monitoring systems. And the historical aspects of the formation of the concept of "environmental monitoring".</u>	<u>2</u>

	<p><i>Stages of formation of environmental monitoring as a system. Classification of environmental monitoring systems. Approaches to the definition of environmental monitoring objects. Factors, indicators and indicators that are investigated in the environmental monitoring system.</i></p> <p>Literature: 1. pp. 10-22; 2. s. 6-15; 3.s. 7-27.</p> <p><i>The task of the IWS is Air pollution in cities[6. c. 94-97]. Types of monitoring at different territorial levels [6 p. 27-31].</i></p>	
2	<p><u><i>State Environmental Monitoring Program of Ukraine.</i></u> <i>Subjects of the state environmental monitoring system. Functioning of the state environmental monitoring system. Relations between the subjects of the state environmental monitoring system.</i></p> <p>Literature: 1. pp. 22 -32; 2. s. 19-28; 8; 9.</p> <p><i>The task of the IWS is the Concept of the monitoring system of Ukraine [3 p. 59-63]. The current state of monitoring observations [6 p. 49-51].</i></p>	<u>2</u>
3	<p><u><i>Pollution of atmospheric air.</i></u> <i>Categories, placement and number of observation posts. Program and methods of observation. Frequency and number of observations. Principles of selection of pollutants to control their content in the atmosphere. Atmospheric air sampling methods. Meteorological observations during air sampling.</i></p> <p>Literature: 1. pp. 57-72; 2. s. 30-48; 3. pp. 64-84.</p> <p><i>Task on the IWS – Means of measuring air pollution [6 p. 97-111]. Anthropogenic impact on the environment [6 pp. 56-61].</i></p>	<u>4</u>
4	<p><u><i>Conducting sub-phase observations.</i></u> <i>Collection and processing of chemical analysis results. Organization of continuous registration of air pollution.</i></p> <p>Literature: 1. pp. 72-75; 2 pp. 51-53; 3. pp. 100-120.</p> <p><i>Task on the IWS – Sampling Methodology [6 p. 103-111]. Pollution and pollutants [6 p. 16-21].</i></p>	<u>2</u>
5	<p><u><i>Sources and types of surface water pollution.</i></u> <i>Organization of a system for monitoring aquatic environments. Points of observation and control creations. Observation programs.</i></p> <p>Literature: 1. pp. 76-86; 2. pp. 53-68; 3. pp. 124-140.</p> <p><i>Tasks for the IWS – Methodology for sampling groundwater [6 p. 178-181]. Evaluation and forecasting of water quality [3 p. 161-182].</i></p>	<u>4</u>
6	<p><u><i>Methods and terms of sampling.</i></u> <i>Hydrobiological observations of water quality and bottom sediments. Integral indicators for assessing water quality. Monitoring in the field of drinking water and drinking water supply.</i></p> <p>Literature: 1. p. 86-96; 2 p. 69-81; 3. c. 143-149.</p> <p><i>The task for the IWS is sampling of precipitation [6 p. 181-186]. Basic measurement information [7 p. 10-18].</i></p>	<u>4</u>
7	<p><u><i>Sources and types of pollution of the waters of the oceans and seas.</i></u> <i>Points and programs of observations of marine pollution. Subjects and objects of monitoring of sea waters in Ukraine.</i></p> <p>Literature: 1. p. 98-101; 2. pp. 82-87; 3. pp. 188-207.</p> <p><i>Tasks for IWS – Processing of measurement results [7 p. 103-128]. Organization of sanitary and hygienic monitoring of water bodies during water consumption [6 p. 174-178].</i></p>	<u>2</u>
8	<p><u><i>Features of the geological environment.</i></u> <i>Indicators of anthropogenic disturbance of the geological environment.</i></p> <p>Literature: 1. p. 103-105; 2. s. 86-93.</p>	<u>2</u>

	<i>The task at the IWS is to monitor reclaimed land [3 p. 250-264].</i>	
9	<u>Methods of studying anthropogenic changes in the geological environment.</u> Literature: 1. p. 105-108; 2. pp. 93-95. <i>The task of the IWS is the organization and monitoring of land resources [6 p. 161-167].</i>	<u>2</u>
10	<u>Feasibility study of soil monitoring. Sources and types of soil degradation. Indicators of man-made disturbance and soil pollution.</u> Literature: 1. p. 108-114; 2. pp. 97-100; 3. p. 212-232, 10. <i>Tasks on the IWS – Types of soil monitoring in Ukraine [6 p. 141-146].</i>	<u>2</u>
11	<u>Principles of organization of observations on the level of chemical pollution of soils. Organization of observations and control of soil pollution.</u> Literature: 1. p. 115-119; 2. pp. 100-105; 3. c. 240-245. <i>The task at the IWS is soil sampling technology [6 p. 154-161]. Organization of monitoring of soil pollution with heavy metals [3 c. 245-250].</i>	<u>4</u>
12	<u>Global environmental monitoring system. Features of the organization of background monitoring. Climate monitoring. Organization of radiation monitoring.</u> Literature: 1. pp. 125-146; 2. pp. 114-129; 3. pp. 49-54. <i>The task for the IWS is the trans boundary movement of pollution. Trans boundary impact on environmental pollution [9 pp. 264-278].</i>	<u>2</u>
13	<u>Features of biotic monitoring. Ecological and hygienic monitoring. Monitoring of forest ecosystems. Agroecological monitoring.</u> Literature: 1. pp. 147-172; 2. C. 132-154; 3. p. 292-305. <i>The task at the IWS is biotesting the components of the environment. Basic methods of biotesting [6 p. 345-356].</i>	<u>2</u>
14	<u>Socio-environmental monitoring. Features of public environmental monitoring.</u> Literature: 1. pp. 172-188; 2. pp. 160-168. <i>The task of the IWS is to monitor the state of public health [6 p. 255-259].</i>	<u>2</u>
	<u>Just:</u>	<u>36</u>

Practical classes

In the system of professional training of students, practical classes occupy 33% of the classroom load, an important means of prompt feedback. Therefore, practical classes perform not only cognitive and educational functions, but also contribute to the growth of students as creative workers in the field of ecology.

The main objectives of the cycle of practical classes:

- ◆ *help students systematize, consolidate and deepen theoretical knowledge in the field of environmental monitoring;*
- ◆ *teach students techniques for solving practical problems, promote mastery of skills and abilities to perform calculations, graphic and other types of tasks;*
- ◆ *teach them to work with scientific and reference literature, documentation and diagrams;*
- ◆ *to form the ability to learn independently, that is, to master the methods, methods and techniques of self-learning, self-development and self-control.*

No s/n	The name of the topic of the lesson and the list of main questions (list of didactic support, references to literature and tasks for the IWS)	Hours
1	<i>The level of air pollution and obtaining information about the main pollutants.</i> Literature: 11. p. 75-81; 12. p.70-79.	4

	<i>The task at the IWS is to assess the level of the air quality monitoring system in your city and access to information on pollutants, to prepare a presentation and report on the lesson [National and regional reports on the state of the environment in Ukraine].</i>	
2	<i>The level of hydrosphere pollution and obtaining information about the main pollutants.</i> Literature: 11. p. 75-81; 12. <i>The task at the IWS is to establish the availability and assessment of the level of the water quality monitoring system in the surface and underground sources of your city and access to information on the main pollutants, to prepare a presentation and report on the lesson [National and regional reports on the state of the environment in Ukraine].</i>	4
3	<i>The level of soil pollution and the main erosion processes in Ukraine.</i> Literature: 6 pp. 141-146. <i>The task at the IWS is to collect information on the level of soil pollution in the territory adjacent to your city and assess its accessibility to ordinary citizens [National and regional reports on the state of the environment in Ukraine].</i>	4
4	<i>Methods of sampling air, water, soils when monitoring the environment.</i> Literature: 6 pp. 103-111, 6 pp. 154-161, 6 pp. 178-181. <i>The task at the IWS is to evaluate various sampling methods for monitoring air, water and soil, to prepare a presentation on the structure of sampling devices [6 p. 103-111, 6 p. 154-161, 6 p. 178-181].</i>	4
5	<i>Modular control work</i>	2
	<i>Just:</i>	18

6. Independent work of the student

Independent work of students takes 55 % of the time to study the credit module. The main task of students' independent work is to master scientific knowledge in the field of designing water use systems that are not included in the list of lecture issues through personal search for information, the formation of an active interest in a creative approach in educational work. substances of both natural and anthropogenic origin in the environment, and on the basis of the analysis of the processed information, to come to their own reasonable conclusions.

No s/n	The name of the topic submitted for independent study	Number of hours of IWS
<i>Section 1. General provisions</i>		
1	<i>Air pollution in cities [6. c. 94-97]. Types of monitoring at different territorial levels [6 p. 27-31]. Concept of the monitoring system of Ukraine [3 p. 59-63]. The current state of monitoring observations [6 p. 49-51].</i>	7
<i>Section 2. Organization of monitoring of environmental components</i>		
2	<i>Means of removing air pollution [6 p. 97-111]. Anthropogenic impact on the environment [6 pp. 56-61]. Sampling methodology [6 p. 103-111]. Pollution and environmental pollutants [6 p. 16-21]. Groundwater sampling methodology [6 p. 178-181]. Evaluation and forecasting of water quality [3 p.1 61-182]. Sampling of precipitation [6 p. 181-186]. Basic measurement information [7 p. 10-18]. Processing of measurement results [7 p. 103-128]. Organization of sanitary and hygienic monitoring of water bodies during water</i>	18

	<i>consumption [6 p. 174-178]. Monitoring of reclaimed land [3 c. 250-264]. Organization and monitoring of land resources [6 p. 161-167]. Organization and monitoring of land resources [6 p. 161-167]. Types of soil monitoring in Ukraine [6 p. 141-146]. Soil sampling technology [6 p. 154-161]. Organization of monitoring of soil pollution with heavy metals [3 c. 245-250].</i>	
<i>Section 3. Special types of environmental monitoring</i>		
3	<i>Transboundary movement of pollution. Transboundary impact on environmental pollution [9 p. 264-278]. Biotesting of environmental components. Basic methods of biotesting [6 p. 345-356]. Monitoring of public health [6 p. 255-259].</i>	7
	<i>Preparation for the module control work and from sections 1-3</i>	4
	<i>Exam</i>	30
	Total hours	66

Policy and control

7. Policy of the discipline (educational component)

Rules for attending classes and behavior in the classroom

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

Rules for assigning incentive and penalty points

- *Incentive points can be awarded by the teacher solely for performing creative work in the discipline or additional completion of online specialized courses with the receipt of the appropriate certificate:*
 - <https://www.futurelearn.com/courses/artificial-intelligence-for-earth-monitoring>;
 - <https://alison.com/course/diploma-in-environmental-quality-monitoring-and-analysis>;
 - <https://alison.com/course/wildlife-tracking-and-monitoring>.

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

The ethics of deadlines and rescheduling

In case of debts in the discipline or any force majeure circumstances, students should contact the teacher through the available (provided by the teacher) communication channels to solve problematic issues and agree on an algorithm of actions for working out.

Academic Integrity Policy

Plagiarism and other forms of dishonest work are unacceptable. Plagiarism includes the lack of links when using printed and electronic materials, quotes, opinions of other authors. Unacceptable hints and write-offs when writing tests, conducting classes; passing the exam 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 "Igor Sikorsky Kyiv Polytechnic Institute". Read more: <https://kpi.ua/code>

Academic Conduct and Ethics Policy

Students should be tolerant, respect the opinions of others, formulate objections in the correct form, constructively maintain feedback in the classroom.

The norms of ethical behavior of students and employees are defined in Chapter 2 of the Code of Honor of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute". Read more: <https://kpi.ua/code>

8. Types of control and rating system for evaluating learning outcomes (ELO)

Distribution of study time by types of classes and tasks in the discipline in accordance with the working curriculum:

Semester	Study time		Distribution of study hours				Control measures		
	Loans	acad. H.	Lecture	Practical	Lab. Rob.	IWS	MCT	HCW	Semester control
4	4	120	36	18		66	1		Exam. (writing)

The student's rating on the discipline consists of points that he receives for:

The rating of a student from a credit module consists of points that he receives for:

1. student's answers at lectures during express control;
2. two tests (MCT is divided into 2 works lasting 45 minutes each),
3. performance of practical work,
4. answers on the exam.

The system of rating (weight) points and evaluation criterion:

1. Express control at lectures:

Weight score –4.

The maximum number of points when interviewing at a lecture of at least 7 students is $7 \times 4 = 28$ points

Criteria for assessing students' knowledge:

<i>Completeness and signs of response</i>	<i>Points</i>
<i>Clear and complete answer to the question</i>	<i>4</i>
<i>The answer made some inaccuracies or errors</i>	<i>3</i>
<i>The answer does not contain the wording of terms, laws and formulas</i>	<i>2... 1</i>
<i>Answer not credited</i>	<i>0</i>

2. Modular control.

Weight score – 10. The maximum number of points for all tests is: 10 points x 2 works = 20 points

Criteria for evaluating tests

<i>Completeness and signs of response</i>	<i>Points</i>
<i>Full answer to all questions</i>	<i>10</i>
<i>The answer made some inaccuracies</i>	<i>8... 9</i>
<i>This partial answer or in answers to questions and mistakes made</i>	<i>6... 7</i>
<i>This fuzzy answer: missing or made mistakes in formulas, reactions, terms and definitions</i>	<i>4... 5</i>
<i>Unsatisfactory answers to individual questions and the presence of significant errors on other questions are given</i>	<i>1... 3</i>
<i>Control not credited</i>	<i>0</i>

3. Work in practical classes.

Weight score – 3. The maximum number of points in all practical works is: 3 points x 4 p / p = 12 points

Criteria for assessing students' knowledge:

<i>Completeness and signs of response</i>	<i>Points</i>
<i>Clear and timely execution and design of work</i>	<i>3</i>
<i>Mistakes have been made in the work that distort the result</i>	<i>2</i>
<i>Late execution of work, deficiencies in the design</i>	<i>1</i>
<i>Failure to do practical work</i>	<i>0</i>

Thus, the rating semester scale from the credit module is:

$$R_C = 28 + 20 + 12 = 60 \text{ points}$$

The exam component is 40% of R:

$$R_{ex} = 40 \text{ points.}$$

Thus, the rating scale from the credit module is:

$$R = R_C + R_{EZ} = 60 + 40 = 100 \text{ points}$$

The maximum amount of points of the starting component is 60 points. A prerequisite for admission to the exam is the fulfillment of the discipline plan and the starting rating of at least 36 points.

According to the results of educational work in the first 7 weeks, the "ideal student" should score 30 points. At the first certification (8th week), a student receives "enrolled" 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 60 points. At the second certification (14th week), a student receives "enrolled" if his current rating is at least 40 points.

During the exam, students give answers to 4 questions, each of which is estimated at 10 points.

The maximum number of points is $4 \times 10 = 40$ points.

The component of the examination scale is 40% of R:

$$R_{ex} = 40 \text{ points.}$$

Thus, the rating assessment in the discipline is:

$$R = 60 + 40 = 100 \text{ points.}$$

Students who have received an F grade are not allowed to take the exam and must increase their rating.

A prerequisite for admission to the exam is the fulfillment of all ICRs.

Criteria for assessing students' knowledge at the exam:

Completeness and signs of response	Points
Full answer to the question	10
The answer made some inaccuracies	8... 9
This partial answer or in answers to questions and mistakes made	6... 7
This fuzzy answer: missing or made mistakes in formulas, reactions, terms and definitions	4... 5
Unsatisfactory answers to individual questions and the presence of significant errors on other questions are given	1... 3
Answer not credited	0

The sum of the starting points and points for the examination test is transferred to the examination mark according to the table.

Points $R = R_C + R_{ECC}$	ECTS score	Examination grade
95-100	A	Perfectly
85-94	B	well
75-84	C	well
65-74	D	Satisfactory
60-64	E	Satisfactory
Less than 60	Fx	Disappointing

<i>Unaccounted for laboratory work or $R_C < 34$</i>	<i>F</i>	<i>not allowed</i>
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9. Additional information on the discipline (educational component)

An approximate list of questions that are submitted for semester control

1. *Explain the need to create an environmental monitoring system.*
2. *Explain the choice of pollutants to control the atmosphere.*
3. *Describe the subjects and objects of monitoring sea waters in Ukraine.*
4. *Describe the place of environmental monitoring in the structure of the concept of sustainable development.*
5. *Describe air sampling methods.*
6. *Describe the indicators of violation of the geological environment.*
7. *Explain the historical aspects of monitoring formation.*
8. *Describe air sampling by filling vessels of limited capacity.*
9. *Describe the control of changes in the geological environment.*
10. *Explain the main directions of environmental monitoring.*
11. *Characterize air sampling devices.*
12. *Describe ecological and geological studies and their stages.*
13. *Explain the structure of the monitoring system.*
14. *Describe the height, duration and conditions of air sampling.*
15. *To characterize the features of soil monitoring.*
16. *Describe the classification of monitoring systems*
17. *Describe the organization of chemical analysis of air samples.*
18. *Characterize the sources and types of soil degradation.*
19. *Explain the main levels of state monitoring.*
20. *Characterize meteorological observations in the selection of air samples.*
21. *Characterize soil criteria and their types.*
22. *Describe the classification of monitoring systems in the context of observations.*
23. *Characterize the conduct of subfackel observations.*
24. *Describe the observation of the level of soil pollution.*
25. *Explain the monitoring system in the context of environmental management.*
26. *Describe the collection and processing of chemical analysis results of air samples.*
27. *Characterize sampling when observing soils.*
28. *Explain the main types of integral indicators.*
29. *Describe the continuous registration of air pollution.*
30. *Explain global monitoring and its results.*
31. *Explain the tasks of the state monitoring system.*
32. *Characterize the sources of surface water pollution.*
33. *Describe the organization of background monitoring.*
34. *Explain the principles of creation and functioning of the State Monitoring System.*
35. *Describe the types of surface water pollution.*
36. *To characterize climate monitoring and its tasks.*
37. *Explain the structure of the State Monitoring System of Ukraine.*
38. *Describe the main types of wastewater and their origin.*
39. *Describe the first section of climate monitoring.*
40. *Describe the subjects of the State Monitoring System.*
41. *Describe surface water monitoring.*
42. *Describe the second section of climate monitoring.*
43. *To characterize the metrological support of the State Monitoring System.*
44. *Describe surface water monitoring facilities.*
45. *To characterize the third section of climate monitoring.*
46. *To characterize the methodological support of the State Monitoring System.*

47. Describe the main provisions of the Water Framework Directive 2000/60/EC.
48. Describe the fourth section of climate monitoring.
49. Explain the relationship of the subjects of the monitoring system.
50. Describe the points of observation of the state of surface waters.
51. Characterize satellite climate monitoring.
52. To characterize the project of the monitoring system of Kyiv.
53. Describe the places of mandatory installation of surface water observation points.
54. Characterize radiation monitoring.
55. Describe the concepts of "monitoring the atmosphere" and "air pollution"
56. Characterize the categories of observation points on surface water bodies.
57. To characterize the radioecological monitoring system "GAMMA".
58. Describe the development of systems for monitoring the state of the atmosphere.
59. Describe the definition of creatures when observing surface water bodies.
60. Describe biotic monitoring.
61. To characterize the tasks of the atmosphere monitoring network.
62. To characterize surface water observation programs.
63. Explain the principles of biotic monitoring with the help of plants.
64. Characterize the natural pollution of the atmosphere.
65. Describe the methods of sampling water from surface water bodies.
66. To characterize the principles of biotic monitoring with the help of animals.
67. Describe artificial air pollution.
68. Describe the timing of sampling water from surface water bodies.
69. Characterize ecological and hygienic monitoring.
70. Characterize the main sources of air pollution.
71. To characterize hydrobiological observations of the quality of surface waters.
72. Describe the assessment of toxico-mutagenic background of soils and water sources.
73. Describe the classification of man-made sources of air pollution.
74. To characterize the hydrobiological observations of the bottom sediments of surface water bodies.
75. Describe the assessment of toxicity using the "Growth Phytotest".
76. Describe the definition of the number of atmospheric observation posts.
77. To characterize the classes and categories of surface water quality.
78. Describe the monitoring of forest ecosystems.
79. Characterize the choice of location of atmospheric observation posts.
80. Explain the integral indicators of surface water quality.
81. Explain agroecological monitoring programs.
82. Describe atmospheric surveillance programs.
83. To characterize the monitoring of drinking water and drinking water supply.
84. Characterize agroecological monitoring.
85. Describe the frequency and duration of observations of the atmosphere.
86. To characterize the sources and types of pollution of the seas and oceans.
87. To characterize social and environmental monitoring.
88. Describe the types of MPC in the atmosphere.
89. Describe observations of marine water pollution.
90. To characterize public environmental monitoring.

Questions for tests

MKR 1

No1.

1. The concept of atmospheric air monitoring.
2. Observation programs.
3. Subfakel observations.
4. Process eutrophication.

5. The concept of creating a point of observation.

No2.

- 1. Structure and composition of the stratosphere.*
- 2. Stationary observation posts.*
- 3. Frequency and number of observations.*
- 4. Classification of wastewater.*
- 5. Vertical and horizontal of creation.*

No3.

- 1. Route post of observations.*
- 2. Atmospheric air sampling methods.*
- 3. Coli-titer and coli-index*
- 4. In the case of organizing a network of observations of reservoirs.*
- 5. Programs of observations on hydrological and hydrochemical parameters.*

No4.

- 1. Natural and artificial air pollution.*
- 2. Mobile sub-phase observation post.*
- 3. The concept of water consumers and water users.*
- 4. Biochemical oxygen consumption.*
- 5. Water sampling methods.*

No5.1. The main sources of air pollution.

- 2. The choice of the location of posts.*
- C. Chemical oxygen consumption.*
- 4. Mandatory objects for the establishment of observation points on water bodies.*
- 5. Terms of water sampling.*

No6.

- 1. Gas composition of the atmosphere.*
- 2. Requirements for a standard network of surveillance points*
- 3. Ways of entry of pollutants into surface water bodies.*
- 4. Monitoring the state of surface waters.*
- 5. Categories of points of the stationary network of observations of reservoirs.*

MKR 2

№1.

- 1. Sources and types of pollution of the waters of the oceans.*
- 2. The concept of "geological environment".*
- 3. General characteristics of the soil.*
- 4. Global monitoring and its tasks.*
- 5. Evaluation of toxico-mutagenic background of atmospheric air.*

№2.

- 1. Points of observation of the quality of sea waters.*
- 2. The concept of external and internal components of the HS.*
- 3. Subjects of soil monitoring.*
- 4. Background monitoring sections.*
- 5. Assessment of the toxicity of environmental objects with the help of the "Growth Phytotest".*

№3.

- 1. Programs for monitoring the quality of sea waters.*
- 2. The main types of soil degradation.*

3. *Retrospective observations of the state of HS.*
4. *The fourth section of climate monitoring.*
5. *Methods of passive bioindication*

№4.

1. *Points of observation of the quality of sea waters.*
2. *Soil criteria for assessing the condition of the soil.*
3. *Basic approaches in assessing the ecological state of territories.*
4. *The fourth section of climate monitoring.*
5. *Block diagram of ecological and hygienic monitoring.*

№5.

1. *Programs for monitoring the quality of sea waters.*
2. *The content of humus in the soils of Ukraine.*
3. *The concept of external and internal components of the HS.*
4. *The main goals of global monitoring.*
5. *Block diagram of ecological and hygienic monitoring.*

№6.

1. *Pollution of ocean waters with petroleum products.*
2. *The main functions of the subjects of soil monitoring.*
3. *Stationary monitoring of the state of the HS.*
4. *Coefficients of technophilia and geochemical equilibrium.*
5. *Satellite climate monitoring.*

Work program of the discipline (syllabus):

Compiled prof., Doctor of Technical Sciences, Radovenchyk V.M.

Approved by the Department ___E and PPT___ (protocol No. 14 of 8.06.2022)

Approved by the FCE Methodical Commission (Protocol No. 10 of 24.06.2022)