

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

Department of General Ecology, Radiobiology and Safety of Life Activity

"CONFIRMED"
Dean of the Faculty of Plant Protection,
Biotechnologies and Ecology
Yulia KOLOMIETS
Protocol №9 dated "18" May 2023 p.

"APPROVED"
at the meeting of the department of General Ecology,
Radiobiology and Safety of Life Activity
Protocol №9 dated "19"04.2023 p.

Head of Department
Alla KLEPKO

"REVIEWED"
Program Coordinator "Ecology"
Program Coordinator
Volodymyr BOGOLYUBOV

PROGRAM OF THE COURSE

Environmental Monitoring

Specialization 101 Ecology
Educational program "Ecology"
Faculty (Institute) Faculty of Plant Protection, Biotechnologies and Ecology
Developers: docent Rakoid O.O., PhD on agrarian sciences
(position, academic degree, academic title)

Kyiv – 2023 p.

1. Description of the course

Environmental Monitoring

(title)

Field of knowledge, specialization, educational program, educational degree		
Educational degree	<i>Bachelor's</i>	
Specialization	<i>101 Ecology</i>	
Educational program	<i>"Ecology"</i>	
Characteristics of the course		
Type	Compulsory	
Total number of hours	120	
Number of ECTS credits	4	
Number of content modules	2	
Course project (work) (if applicable)	c.p.	
Form of assessment	<i>Exam</i>	
Indicators of the course for full-time and part-time forms of study		
	Full-time form of study	Part-time form of study
Course (year of study)	3	
Semester	5	
Lecture classes	<i>30 hr.</i>	<i>hr.</i>
Practical, seminar classes	<i>hr.</i>	<i>hr.</i>
Laboratory classes	<i>30 hr.</i>	<i>hr.</i>
Self-study	<i>60 hr.</i>	<i>hr.</i>
Individual assignments	<i>hr.</i>	<i>hr.</i>
Number of weekly classroom hours for the full-time form of study	<i>4 hr.</i>	

2. Purpose, objectives, and competencies of the course

Purposes of discipline are to expand the object, methods and place of the discipline "Environmental monitoring" in the system of environmental knowledge as well as highlight its main principles; to introduce the main sections of the discipline; to promote ecological outlook for future environmentalists.

Objectives of the discipline is formation the theoretical knowledge and practical skills in the field of environmental monitoring, in particular on the modern problems of different components of the environment (surface and ground water, oceans and seas, atmospheric air, soils etc.), estimation of impact of anthropogenic stresses on them, prediction of changes in the state of environment as well as working out the scientifically-grounded recommendations for realization of nature protection measures.

Acquisition of competencies:

Integrated competency (IC): Ability to solve complex specialized problems and solve practical problems in the field of ecology, environmental protection environment and balanced environmental management, which involves the application of basic

theories and methods of environmental sciences, characterized by complexity and uncertainty of conditions.

General competencies (GC):

GC2. Skills in the use of information and communication technologies.

GC6. Ability to communicate with representatives of other professional groups of different levels (with experts from other fields of knowledge/economic activities).

Professional (special) competencies (PC):

PC7. Ability to conduct environmental monitoring and assess the current state of the environment.

PC10. Ability to use modern information resources for environmental research.

PC13. Ability to contribute to the management of environmental actions and/or environmental projects.

Program learning outcomes (PLO):

PLO5. To know the conceptual basis of monitoring and rationing of anthropogenic load on the environment.

PLO10. Be able to apply software tools, GIS technologies and Internet resources for information support of environmental studies.

PLO15. Be able to explain the social, economic and political implications of implementing environmental projects.

3. Program and structure of the course for:

– complete full-time (part-time) form of study;

Names of content modules and topics	Number of hours													
	full-time							part-time						
	weeks	in total	including					in total	including					
			L	Pr	Lab	In d	Sw		L	Pr	Lab	in d	Sw	
1	2	3	4	5	6	7	8	9	10	11	12	13	14	
Content Module 1. Fundamentals of environmental monitoring. National framework of monitoring														
Topic 1. Basic concepts of environmental monitoring	1-2	15	4		4		7							
Topic 2. The State Environmental Monitoring System of Ukraine	3-4	15	4		4		7							
Topic 3. Air pollution and air monitoring	5-6	16	4		4		8							
Topic 4. Monitoring of surface water	7-8	16	4		4		8							
In total for meaningful module 1		62	16		16		30							
Content Module 2. Environmental approach in ecological monitoring														
Topic 1. Land and soil monitoring. Assessment of land degradation	9-10	16	4		4		8							

Topic 2. Climate change and climate monitoring	11-12	15	4		4		7						
Topic 3. Monitoring of biodiversity (Biomonitoring)	13-14	16	4		4		8						
Topic 4. Global approaches for environmental monitoring	15	11	2		2		7						
In total for meaningful module 2		58	14		14		30						
Total number of hours		120	30		30		60						
Course project (work)		c.p.											
Total number of hours		120	30		30		60						

4. Seminar topics

№	Topic title	Number of hours
1		
2		
...		

5. Practical class topics

№	Topic title	Number of hours
1		
2		
...		

6. Laboratory class topics

№	Topic title	Number of hours
1	Definitions and historical background of monitoring. Classification of monitoring system	4
2	Regulatory and policy framework of SEMS	4
3	Analytical research methods of air condition	4
4	Physical and chemical parameters of water quality monitoring	4
5	Agroecological monitoring. Methods for determining the contaminant concentration in soils	4
6	Characteristics and uses of climate observations at the global and national levels	4
7	International approaches to biomonitoring. Indicators used to conduct monitoring biodiversity at the global and national levels	4

8	World experience in organizing environmental monitoring systems	2
---	---	---

7. Independent work topics

No	Topic title	Number of hours
1	Factors and indicators that are studied in environmental monitoring	7
2	Informational support of SEMS. Data base organization and management	7
3	Causes and sources of air pollution in Ukraine	8
4	Monitoring over ocean and sea water pollutants	8
5	Methodological and technical support of geoecological monitoring	8
6	The main sources of radioactive contamination. Radioecological control of soils, water and food	7
7	Biodiversity monitoring programmes for endangered species	8
8	Ecological and hygienic monitoring	7

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

Samples of control questions

1 The environmental monitoring provides (exclude the wrong answer):

1) *observation of the environment and the factors that affect the separate elements of the environment*

2) *evaluation and analysis of the actual state of all components of the environment*

3) *predictions of the state of environment and evaluation of the environmental condition*

4) *providing scientific information to support for management decision making*

5) *participation in bilateral agreements*

2 The principles of classification of current monitoring systems

1 By universality of system	A Monitoring of anthropogenic changes in atmosphere, hydrosphere and lithosphere
2 By the main components of the biosphere	B Aerospace monitoring (remote sensing methods) Monitoring of physical, chemical and biological parameters
3 By the methods of observation	C Global, national, "international", regional

3 When and where was the 1-st Intergovernmental Meeting on Monitoring held?

4 Please specify a few legislative acts of Ukraine in the field of environmental protection and monitoring

5. What are the types of environmental monitoring (according to Resolution of the Cabinet of Ministers of Ukraine, 1998)?

6 Classification of priority pollutants by priority classes

1	A Nitrates, nitrites, Nitrogen oxide
2	B Sulfur dioxide, suspended solids, Radionuclides ($^{90}\text{Sr} + ^{137}\text{Cs}$)
3	C Microtoxins, Microbiological pollution, Reactive pollution
8	D Ozone, DDT (dichlorodiphenyltrichloroethane) and other chloroorganics, Cadmium and its compounds

7 What is the only principle in the system of environmental monitoring in Ukraine?

8. Basic blocks in the structure of the monitoring system are:

9 How many levels have the system of environmental monitoring of Ukraine? Name them.

10 Substance hazard categories:

1 Extremely hazardous substance	A sulfur dioxide, butyl alcohol, dust
2 Highly hazardous substance	B benzopyrene, lead, mercury and chromium compounds, hexachlorane, hydrogen cyanide, DDT, ozone
3 Moderately hazardous substance	C sulfuric acid, hydrogen sulfide, caffeine, phenols, nitrogen dioxide, benzene, chlorine, manganese oxides
4 Low-hazardous substance	D carbon monoxide, ethanol, ammonia, naphthalene, acetone, turpentine

11 What is the only principle in the system of environmental monitoring in Ukraine?

12 The main bodies of State Environmental Monitoring System of Ukraine (choose the right answers):

- *Ministry of Environment and Natural Resources of Ukraine*
- *Hydrometeorological Service*
- *Ministry of Internal Affairs of Ukraine*
- *Ministry of Agrarian Policy and Food of Ukraine*
- *State Forest Resources Agency of Ukraine*
- *State Water Resources Agency of Ukraine*
- *State Land Resources Agency of Ukraine*
- *State Statistic Service of Ukraine*
- *State Service of Geology and Mineral Resources of Ukraine*

13 Who is ensured the organizational integration of environmental monitoring bodies at all levels in Ukraine?

14 When and where was the 1-st Intergovernmental Meeting on Monitoring held?

15 Global multilateral environmental agreements and obligations:

1 UN Framework Convention on Climate Change	A Kyoto, 1997
2 Kyoto Protocol	B Paris, 1994
3 Convention on Biological Diversity	C Rio-de-Janeiro, 1992
4 UN Convention to Combat Desertification	D New-York, 1992

16. Name several major components of dry clean air in ground atmospheric layer

17. Air pollution damages environment over (exclude the wrong answer):

- a) *Acidification*
- b) *Aesthetic damage*
- c) *Eutrophication*
- d) *Crop damage*

18. In Ukraine, concentrations of ozone, PM_{2.5} and PM₁₀ are not controlled in human settlements (yes or no)

19. Who are the main air polluters in Ukraine?

20. What body monitors centralized and de-centralized sources of drinking water supply, recreation areas along rivers and water reservoirs?

21. Why the pH of an aquatic ecosystem is so important?

22. What are the two nutrients that most commonly limit maximum biomass of algae and aquatic plants in aquatic systems?

23. The pollutants that include to the program of air quality monitoring:

1 for mandatory monitoring	A arsenic and mercury
----------------------------	-----------------------

2 according to local peculiarities of human settlements	B dust, nitrogen dioxide, sulfur dioxide, carbon monoxide, formaldehyde, lead and benzo(a)pyrene
3 when the need arises	C ammonia, benzene, phenol, hydrogen sulfide, anhydrous hydrogen fluoride, toluene and other

24. Trophic levels can be done for the monitoring of biological communities of water bodies:

1 micro-organisms	A algae and vascular plants
2 primary producers	B fish
3 primary consumers	C bacteria, protists, and viruses
4 secondary consumers	D invertebrates

25. Degraded soils can be damaged in several ways (choose the wright answers):

- 1) by physical compaction and loss of aggregate stability;
- 2) in lower agricultural yields;
- 3) through soil acidification, salinity, erosion and desertification.

26. Soil fertility depends on several factors such as: (choose the correct answers)

- 1) soil texture;
- 2) humus content;
- 3) level of plant nutrients.

27. How Soil contamination index is calculated?

28. What trend can we see in global temperature?

29. The Essential Climate Variables (ECVs): (choose the correct correspondences)

1 Atmospheric	A currents
2 Oceanic	B albedo
3 Terrestrial	C wind speed and direction

30. What objects should be priority for the first stage of the biomonitoring development?

Sets of tests

НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ БІОРЕСУРСІВ І ПРИРОДОКОРИСТУВАННЯ УКРАЇНИ			
ОС «Бакалавр» Спеціальність 101 Екологія	Кафедра загальної екології, радіобіології та безпеки життєдіяльності 202_-202_ навч. рік	ЕКЗАМЕНАЦІЙНИЙ БІЛЕТ № 1 з дисципліни Environmental monitoring (Моніторинг довкілля)	Затверджую Зав. кафедри (підпис) А.В. Клепко _____2023 р.
Екзаменаційні запитання			
1. What are the main features of the Procedure for monitoring in the field of atmospheric air protection?			
2. What is the goal of environmental indicators?			
Тестові завдання різних типів			
1. Classification of priority pollutants by priority classes			
1. 1 class	A DDT and other chlororganic compounds		
2. 2 class	B Microbiological contaminations		
3. 8 class	C Sulfur dioxide, particulate matters		
2. What subsystems of SEMS are regulated by the monitoring procedure?			
a. Background environmental monitoring;			
b. Monitoring in the field of atmospheric air protection;			
c. Forest monitoring;			
d. State water monitoring;			
e. Monitoring of fauna;			
f. Land monitoring (land and soil monitoring).			
3. The highest concentrations are observed of particulate matter (PM _{2.5} and PM ₁₀) in Ukraine are observed in:			
a. around urban areas;			
b. industrial region of eastern Ukraine;			

c. in areas of intense military operations.	
4. Hygienic MACs are aimed at ensuring safe conditions of water use for fisheries.	
Yes	No
5. Depending on the level of atmospheric air pollution by one or another pollutant from List A, the following regimes are applied:	
1. mode of fixed measurements 2. mode of combined estimation 3. mode of modelling or objective assessment	A applied when pollutant levels are below the lower assessment threshold B carried out on fixed observation networks C provides a combination of fixed measurements and modelling method
6. How frequently is the eco- agrochemical passportization of fields and land areas carried out?	
7. Priority communities for biomonitoring are those listed in:	
a. the Red Data Book of Ukraine;	
b. the Green Data Book of Ukraine;	
c. the Cadastre of plant wildlife.	
8. Monitoring of waste generation, storage and disposal sites is a subsystem of the state environmental monitoring system.	
Yes	No
9. Where are automatic sensors typically used for water monitoring?	
a. Water filtration, sample fixation, sample freezing;	
b. Microbial contamination;	
c. Basic physical-chemical properties of waters including oxygen content, pH, conductivity.	
10. Air pollution includes contaminants in the form of ... or ... (fill in omitted words).	

9. Teaching methods.

When studying the discipline, the following methods of teaching are used:

Depending on the source of knowledge: verbal (explanation, conversation, discussion, dialogue); visual (demonstration, illustration); practical (problem solving, business games).

By the type of cognitive activity: explanatory-visual problematic presentation, partly search and research methods.

By place in learning activities:

- methods of organization and implementation of learning activities, combining verbal, visual and practical methods; reproductive and problem-solving; methods of learning work under the guidance of a teacher and methods of independent work of higher education applicants;

- methods of control and self-control of learning activities: methods of oral and written control; individual and frontal, thematic and systematic control.

In the process of teaching the academic discipline to intensify the educational and cognitive activity of applicants for higher education the use of such educational technologies is provided:

- work in small groups allows to structure practical seminars in form and content, creates opportunities for participation of each applicant for higher education in the work on the topic of the class, provides the formation of personal qualities and experience of social communication;

- seminars-discussions involve the exchange of opinions and views of the participants about the topic, as well as develop thinking, help to form views and beliefs, the ability to formulate thoughts and express them, learn to evaluate the proposals of others, and critically think about their own views;

- brainstorming as a method of solving urgent problems, the essence of which is to express as many ideas as possible in a limited amount of time, to discuss and carry out their selection;

- case method - a method of case studies, which allows to bring the learning process closer to the real practical activity of specialists and involves the consideration of production, management and other situations, complex conflict cases, problem situations, incidents in the study of educational material;

- presentations - speeches to an audience, which are used to present certain achievements, group results, report on the performance of individual tasks, instruction, and demonstrations.

10. Forms of assessment

In accordance with the Regulations on the examinations and credits at the National University of Life and Environmental Sciences of Ukraine, approved by the Academic Council of NUBiP Ukraine on April 26, 2023, Protocol № 10, the types of knowledge control of higher education are the current control, intermediate and final attestation.

Current control of the discipline is carried out during the practical purposes, and aims to test the level of preparedness of applicants for higher education to perform specific work.

Intermediate attestation is held after the study of program material and should determine the level of knowledge of applicants for higher education in the program material obtained in all types of classes and independent work.

The form of the intermediate attestation is testing.

The mastering of the program material by a higher education applicant is considered successful if his rating score is at least 60 points on a 100-point scale.

Semester certification is held in the form of semester exam.

Applicants for higher education are required to take exams and credits in accordance with the requirements of the working curriculum in the time provided by the schedule of the educational process. The content of exam is determined by the working training program of the discipline.

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 24.04.2023, protocol №10).

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): $R_{dis} = R_{aw} + R_{ex}$.

11. Educational and methodological support.

1. Закон України «Про охорону навколишнього природного середовища» № 1264-XII від 25.06.1991 р. (зі змінами). URL: <https://zakon.rada.gov.ua/laws/show/1264-12#Text>

2. Положення про державну систему моніторингу довкілля. Затверджено Постановою Кабінету Міністрів України від 30 березня 1998 р., № 391. URL: <https://zakon.rada.gov.ua/laws/show/391-98-%D0%BF#Text>

3. Положення про моніторинг земель, затверджене постановою Кабінету Міністрів України від 20 серпня 1993 р. № 661, <https://zakon.rada.gov.ua/laws/show/661-93-%D0%BF#n11>

4. Порядок здійснення державного моніторингу в галузі охорони атмосферного повітря, затверджений Постановою Кабінету Міністрів України від 14 серпня 2019 р. № 827, <https://zakon.rada.gov.ua/laws/show/827-2019-п#Text>

5. Порядок здійснення державного моніторингу вод, затверджений постановою Кабінету Міністрів України від 19 вересня 2018 р. № 758, <https://zakon.rada.gov.ua/laws/show/758-2018-%D0%BF#n11>

8. Rakoid O.O., Bogoliubov V.M., Klepko A.V., Bondar V.I. Environmental monitoring. Textbook. Kyiv: NUBIP, 2023. 332 p.

9. Rakoid O.O., Bogoliubov V.M. Environmental monitoring. Study guide. Kyiv: NUBIP, 2019. 301 p.

10. Моніторинг довкілля: підручник / [Боголюбов В.М., Клименко М.О., Мокін В. Б. та ін.]; за ред. проф. В.М. Боголюбова. Вид. 2-ге, переробл. і доповн. – Київ: НУБіПУ, 2018. 435 с.

11. Моніторинг довкілля. Аналітична записка щодо стану та перспектив розвитку державної системи моніторингу довкілля. Київ, 2023 р. 119 с.

12. Чугай А. В. Моніторинг довкілля (стану природних середовищ): конспект лекцій. Одеса: ОДЕКУ, 2022. 156 с.

13. Національна доповідь про стан навколишнього природного середовища в Україні у 2021 році. URL: <https://mepr.gov.ua/wp-content/uploads/2023/01/Natsdopovid-2021-n.pdf>

14. Методи оцінки техногенного впливу на довкілля: навч. посіб. / А.В. Чугай, Т.А. Сафранов. Одеса: Видавець Букаєв Вадим Вікторович, 2021. 118 с.

15. Ананьєва Т.В. Моніторинг довкілля. Практикум: навч. видання. / Т.В.Ананьєва. Херсон: ОЛДІ-ПЛЮС, 2021. 172 с.

16. Сальнікова А.В., Боголюбов В.М. Робочий зошит для проведення практичних робіт з дисципліни Моніторинг довкілля для студентів денної форми навчання ОС Бакалавр за спеціальністю «101 Екологія». К.: НУБіП, 2021 р. 82 с.

12. Recommended sources of information

1. European Environment Agency: <http://www.eea.europa.eu/>

2. Information and analytical data base “Environmental passport of the regions of Ukraine”: <http://ukrecopass.org.ua/>
3. Bulletin “State of Ground Waters of Ukraine”: <http://www.geoinf.kiev.ua/>
4. Bulletin “Annual Bulletin on the State of Rivers of Ukraine”: <http://www.cgo.kiev.ua/>
5. Climatic cadastral register of Ukraine: <http://www.cgo.kiev.ua/>
6. World Data Center for Geoinformatics and Sustainable Development: <http://wdc.org.ua/en/services/ukraine-sd>
7. ЕкоСистема, національна онлайн-платформа, яка містить актуальну інформацію про стан довкілля: <https://eco.gov.ua/>
8. Міністерство захисту довкілля та природних ресурсів України: <https://data.gov.ua/organization/ministerstvo-ekolohiyi-ta-pryrodnykh-resursiv-ukrayiny>
9. Державне агентство водних ресурсів України: <https://data.gov.ua/organization/derzhavne-ahentstvo-vodnykh-resursiv-ukrayiny>
10. Веб-сайт ГО «Екодія»: <https://ecoaction.org.ua/>
11. Copernicus, the Earth observation component of the European Union’s Space programme: <https://www.copernicus.eu/en>