

PERSPECTIVE RESEARCH DIRECTIONS IN ENVIRONMENTAL PROTECTION.
PART 1. ANALYSIS OF ACTUAL PROBLEMS OF ENVIRONMENTAL PROTECTION

Work program of the educational component (Syllabus)

Details of the educational component

Higher education level	<i>Second (Master's)</i>
Field of Knowledge	<i>E Natural Sciences, Mathematics and Statistics</i>
Speciality	<i>E2 Environmental studies</i>
Educational program	<i>Environmental safety</i>
Status of the educational component	<i>Normative</i>
Form of study	<i>full-time (full-time)/remote/mixed</i>
Year of preparation, semester	<i>1st year, autumn semester</i>
Scope of the educational component	<i>10/(300)</i>
Semester control / control measures	<i>Exam</i>
Class schedule	<i>9.07 hours per week (1.07 hours of lectures and 8 hours of laboratory classes)</i>
Language of instruction	<i>Ukrainian</i>
Information about the course leader / teachers	Speaker: https://eco-paper.kpi.ua/pro-kafedru/vykladachi/nosachova-yuliya-viktorivna.html
Course placement	https://do.ipk.kpi.ua/course/view.php?id=2151

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

1.1. The purpose of the educational component.

The purpose of the educational component is to form the following competencies in students:

- Ability to learn and master modern knowledge;
- Ability to generate new ideas (creativity);
- Ability to search, process and analyze information from various sources;
- Ability to develop and improve methods and technologies;
- • Awareness at the level of the latest achievements necessary for research and/or innovation activities in the field of ecology, environmental protection and balanced nature management;
- Ability to use the principles, methods and organizational procedures of research and/or innovation activities;
- Ability to organize work related to environmental assessment, environmental protection and optimization of nature management, in conditions of incomplete information and contradictory requirements
- Ability to assess the level of negative impact of natural and anthropogenic environmental hazards on the environment and humans.

1.2. The main program learning outcomes of the educational component.

According to the requirements of the educational-professional and educational-scientific program, students, after mastering the educational component, must demonstrate the results of learning:

- Know and understand fundamental and applied aspects of environmental sciences
- Be able to use conceptual ecological patterns in professional activities
- Know at the level of the latest achievements the basic concepts of natural science, sustainable development and methodology of scientific knowledge
- Demonstrate the ability to organize collective activities and implement complex environmental projects, taking into account available resources and time constraints
- Demonstrate awareness of the latest environmental principles and practices
- Be able to use modern information resources on ecology, nature management and environmental protection
- Be able to assess landscape and biological diversity and analyze the consequences of anthropogenic impact on natural environments
- Be able to assess the potential impact of man-made objects and economic activities on the environment
- Apply new approaches to develop a decision-making strategy in difficult unpredictable conditions
- Assess environmental risks under conditions of insufficient information and conflicting requirements
- Choose the optimal management and/or environmental management strategy depending on environmental conditions
- Critically comprehend theories, principles, methods and concepts from various subject areas to solve practical problems and problems of ecology
 - Be able to use modern methods of processing and interpreting information in carrying out innovative activities
- Be able to independently plan the implementation of an innovative task and formulate conclusions based on its results
- Know modern approaches to the organization of environmentally friendly production, reorganization and reconstruction of existing industries from the standpoint of resource saving, taking into account the life cycle of the product
 - To analyze the results of environmental control of enterprises, to assess the engineering and technical level of environmental protection from the harmful effects of production

2. PREREQUISITES AND POST-REQUISITES OF THE EDUCATIONAL COMPONENT (PLACE IN THE STRUCTURAL AND LOGICAL SCHEME OF TRAINING ACCORDING TO THE RELEVANT EDUCATIONAL PROGRAM)

Educational component "Promising areas of scientific research in environmental protection. Part 1. Analysis of Current Problems of Environmental Protection" provides educational components,

"Promising areas of scientific research in environmental protection. Part 2. Theoretical and Experimental Solution of Scientific Problems", master's thesis.

3. CONTENT OF THE EDUCATIONAL MATERIAL

Chapter 1. General information about the concept of science.

General information about the concept of science. The main tasks of science. Science as a system of knowledge. System of organization of scientific research. System of training of scientific personnel.

Chapter 2. Methodology of scientific research

Methods of scientific research. Methods of empirical level research. Methods of theoretical level of research. Basic rules for putting forward and testing a hypothesis. Requirements for new theories. Methods of theoretical and empirical levels of research. The main stages of scientific research.

Chapter 3. Information search in scientific research

Scientific information and its organization. The most important sources of information in the field of ecology. Abstract information. Express information. Patent information. Patent search. Methods of working with scientific literature.

Chapter 4. Mathematical planning of the experiment

Planning of experiments and its tasks. Basic concepts of the mathematical theory of experiment planning. Full factor experiment. Fractional factor experiment.

Chapter 5. Conducting experimental research

General concepts of experiment. Development and design of laboratory installations. Organization and conduct of experimental research. Measurements, measuring instruments and their characteristics. Modeling of physical phenomena and technical devices.

Chapter 6. Processing the results of experimental research and their design

Statistical analysis of the results of the experiment. Determination of experiment errors. Detection of gross errors. The use of computers in scientific research. Preparation of experimental research results for publication. Preparation of an article, report, abstract. Deposit of handwritten works. Special requirements for the design of materials of various scientific journals. Legislation of Ukraine on Patenting. Registration and filing of an application for an invention, patent. Algorithm for solving inventive problems. Registration of research results in the form of a scientific report. Structure of the R&D report. Requirements for its registration.

Training materials and resources

Basic

1. Nosacheva Yu.V., Ivanenko O.I., Radovenchyk Y.V. *Fundamentals of Scientific Research*. Kyiv: Condor Publishing House, 2020. – 294 p. 130 p. (in Russian).
2. *Promising areas of scientific research in environmental protection. Laboratory practicum [Electronic resource]: study. Manual. for students. specialty 101 "Ecology" / KPI. Igor Sikorsky; compiled by: T. O. Shabliy, Y. V. Nosachova, O. I. Ivanenko. – Electronic text data (1 file: 131 KB). – Kyiv: KPI. Igor Sikorsky, 2022. – 86 p. (in Russian).*

Secondary

3. Partyko Z. *Fundamentals of scientific research. Preparation of a dissertation*. – Kyiv: Lira-K, 2017. – 232 p. (in Russian).
4. Kolesnikov O. V. *Fundamentals of scientific research*. – Kyiv: TsNL, 2019. – 144 p. (in Russian).
5. Anatoly Konversky. *Fundamentals of methodology and organization of scientific research*. – Kyiv: TsNL, 2019. – 350 p. (in Russian).
6. *State Standard of Ukraine. DSTU 8302:2015 Information and documentation. Bibliographic reference. General provisions and rules of assembly.*

Information resources on the Internet

<https://www.grafiati.com/uk/>

<http://ukrlit.org/transliteratsiia#source=0jhqu9c+0yjquc40l3qsa==>

Professional Association of Ecologists of Ukraine (PAEU) - <https://pae.com.ua/>

Educational content

1. Methods of mastering the educational component

Lectures

Lectures are aimed at:

- provision of modern, holistic, interdependent knowledge on the educational component "Promising areas of scientific research in environmental protection", the level of which is determined by the target setting for each specific topic;
- ensuring the creative work of students together with the teacher during the lecture;
- education of students' professional and business qualities and the development of independent creative thinking;
- formation of students' necessary interest and provision of direction for independent work;
- determination of the development of science and technology in the field of environmental protection at the current level, forecasting their development for the coming years;
- reflection of methodological processing of the material (highlighting the main provisions, conclusions, recommendations, clear and adequate to their formulation);
- use of visual materials for demonstration, combining, if possible, them with the demonstration of results and samples;
- presentation of research materials in a clear and high-quality language in compliance with structural and logical connections, explanation of all newly introduced terms and concepts;
- accessibility for perception by this audience.

No. s/p	Title of the topic of the lecture and a list of main questions (list of didactic tools, references to literature and tasks on the SRS)	Number of hours
1	General information about the concept of science. General information about science. The main tasks of science. Science as a system of knowledge. [1, p. 6-21]. System of organization of scientific research. System of training of scientific personnel. [3, p. 40-47], [4, p. 25-30], [5, p. 84-93]. Tasks for the SRS – To analyze the systems of training of scientific personnel in different countries [1]	4
2	Methodology of scientific research. Methods of scientific research. Methods of empirical level research. Methods of theoretical level of research. Basic rules for putting forward and testing a hypothesis. Requirements for new theories. [1, p. 23-31]. Methods of theoretical and empirical levels of research. The main stages of scientific research. [3]. Tasks on the SRS - The role of logical methods in scientific research. [5]	4
3	Information search in scientific research Scientific information and its organization. The most important sources of information in the field of ecology. [1, p. 50-67], [5, p. 49-66]. Abstract information. Express information. Patent information. Patent search. Methods of working with scientific literature [1]. The task on the SRS is to analyze the concepts and types of catalogs [3, 5].	4
4	Psychology of scientific creativity Scientific thinking, methods of activating scientific thinking [5].	4
	Just	16

Laboratory classes

In the system of professional training of students, laboratory classes occupy 88.2% of the classroom load. As a supplement to the lecture course, they lay and form the foundations for the qualification of a Master in Ecology. The purpose of laboratory and practical classes is to develop students' experimental skills, a research approach to studying the subject, and consolidate theoretical material.

No. s/p	Name of the laboratory work (computer workshop)	Number of auditoriums. Hours
1	Wastewater treatment from organic contaminants	10

2	Water softening by ion exchange method under static conditions	12
3	Studying the processes of protecting equipment from corrosion	12
4	Ion exchange treatment of wastewater from heavy metals on the example of the removal of chromium ions	12
5	Wastewater treatment from organic substances by ion exchange method	12
6	Destruction of wastewater contaminated with organic substances	12
7	Stabilization of scale formation processes in the aqueous environment	12
8	Use of flocculants to improve the processes of waste paper mass retention on the mesh and dewatering of fibrous sludge of paper and cardboard industries	12
9	Removal of heavy metal ions by sorption on magnetite particles	12
10	Extraction of nickel ions from a spent chemical nickel plating solution	12
11	Modular control work	2
	Total hours	120

Independent work of a student

Independent work takes 54.7% of the time to study the credit module, including preparation for the exam. The main task of students' independent work is to master scientific knowledge that is not included in the list of lecture questions, through personal search for information, the formation of an active interest in a creative approach in educational work.

No. s/p	Name of the topic submitted for independent study	Number of CPC hours
Chapter 1. General information about the concept of science		
1	To analyze the systems of training of scientific personnel in different countries [1]	34
Chapter 2. Methodology of scientific research		
2	The role of logical methods in scientific research. [5]	34
Chapter 3. Information search in scientific research		
3	To analyze the concepts and types of catalogs [3, 4].	34
Chapter 4. Psychology of scientific creativity		
4	The influence of external factors on thinking [5].	37
5	Preparation for the MCR	5
6	Exam preparation	20
	Total hours	164

PROVIDING PROGRAM RESULTS WITH COMPONENTS OF THE EDUCATIONAL COMPONENT

Name of PR	Lectures	Laboratory lessons, individual task
Know and understand fundamental and applied aspects of environmental sciences	General information about the concept of science.	

<i>Be able to use conceptual ecological patterns in professional activities</i>	General information about the concept of science.	<i>Laboratory work 1 -11</i>
<i>Know at the level of the latest achievements the basic concepts of natural science, sustainable development and methodology of scientific knowledge</i>	General information about the concept of science.	<i>Laboratory work 1 -11</i>
<i>Demonstrate the ability to organize collective activities and implement complex environmental projects, taking into account available resources and time constraints</i>	Methodology of scientific research	<i>Laboratory work 1 -11</i>
<i>Be able to clearly and unambiguously convey professional knowledge, own justifications and conclusions to specialists and the general public</i>	Methodology of scientific research	<i>Laboratory work 1 -11</i>
<i>Demonstrate awareness of the latest environmental principles and practices</i>	Methodology of scientific research	<i>Laboratory work 1 -11</i>
<i>Be able to use modern information resources on ecology, nature management and environmental protection</i>	Information search in scientific research	<i>Laboratory work 1 -11</i>
<i>Be able to assess landscape and biological diversity and analyze the consequences of anthropogenic impact on natural environments</i>	Methodology of scientific research	<i>Laboratory work 1 -11</i>
<i>Be able to assess the potential impact of man-made objects and economic activities on the environment</i>	Methodology of scientific research	<i>Laboratory work 1 -11</i>
<i>Apply new approaches to develop a decision-making strategy in difficult unpredictable conditions</i>	Information search in scientific research	<i>Laboratory work 1 -11</i>
<i>Assess environmental risks under conditions of insufficient information and conflicting requirements</i>	Information search in scientific research	<i>Laboratory work 1 -11</i>
<i>Choose the optimal management and/or environmental management strategy depending on environmental conditions</i>	Information search in scientific research Psychology of scientific creativity	<i>Laboratory work 1 -11</i>
<i>Critically comprehend theories, principles, methods and concepts from various subject areas to solve practical problems and problems of ecology</i>	Methodology of scientific research Psychology of scientific creativity	<i>Laboratory work 1 -11</i>

<i>Be able to use modern methods of processing and interpreting information in carrying out innovative activities</i>	Methodology of scientific research	Laboratory work 1 -11
<i>Be able to independently plan the implementation of an innovative task and formulate conclusions based on its results</i>	Information search in scientific research General information about the concept of science.	Laboratory work 1 -11
<i>Know modern approaches to the organization of environmentally friendly production, reorganization and reconstruction of existing industries from the standpoint of resource saving, taking into account the life cycle of the product</i>	Information search in scientific research General information about the concept of science. Psychology of scientific creativity	Laboratory work 1 -11
<i>To analyze the results of environmental control of enterprises, to assess the engineering and technical level of environmental protection from the harmful effects of production</i>	Information search in scientific research General information about the concept of science. Psychology of scientific creativity	Laboratory work 1 -11

Policy and control

4. Policy of the 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's conduct, not to be distracted by actions not related to the educational process.

Rules for assigning incentive and penalty points

Semester certification is carried out in the form of an exam. To assess learning outcomes, a 100-point rating system and a university scale are used.

Rules for assigning incentive and penalty points

- ***Incentive points can be awarded by the teacher only for the performance of creative work in the discipline or additional completion of on-line specialized courses with the receipt of an appropriate certificate:***

<https://www.coursera.org/learn/startup-entrepreneurship-discovering-ideas>

<https://www.coursera.org/learn/numerical-methods-engineers>

<https://prometheus.org.ua/prometheus-free/science-communication-digitalera/>

It is not allowed to take the same course in different semesters. But their amount cannot exceed 10% of the rating scale.

- ***Penalty points are not provided within the educational component.***

Deadline and retake policy

In case of debts from the educational component 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 absence of references when using printed and electronic materials, quotes, opinions of other authors. Hints and cheating are

unacceptable when 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 Section 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, and constructively maintain feedback in the classroom.

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

5. Types of control and rating system for assessing learning outcomes (RSO)

Distribution of study time by types of classes and tasks from the credit module according to the working curriculum

Form teaching	Semesters	Total kr/hours	Distribution of study time by types of classes							Semester certification
			Lecture	Practical classes	Seminar classes	Laboratory work	Computer-Workshop	SRS	FDM	
Daytime/dis tance/mixed	autumn	10/300	16	-	-	120	-	126	1	Exam

* - in accordance with the number of students in the group, the number of lectures, practical and laboratory classes can be proportionally changed taking into account individual classes

1. The student's rating in the credit module is calculated from 100 points, of which 52 points are the starting scale. The starting rating (during the semester) consists of the points that the student receives for:

- performing 10 laboratory works;
- performance of modular control work (MCR is divided into 2 works lasting 45 minutes each).

2. Criteria for awarding points.

2.1. Performing laboratory work:

- impeccable work – 4 points;
- there are certain shortcomings in the preparation and/or performance of work – 3-1 point;
- absence from class without a valid reason – –1 point.

2.2. Tests are evaluated at 6 points:

- "excellent" – complete answer (at least 90% of the required information) – 6-5 points;
- "good" – a sufficiently complete answer (at least 75% of the required information), or a complete answer with minor inaccuracies – 4-3 points;
- "satisfactory" – incomplete answer (at least 60% of the required information) and minor errors – 2-1 points;
- "unsatisfactory" – the answer does not meet the requirements for "satisfactory" – 0 points.

3. The condition for the first certification is to obtain at least 8 points. The condition for the second certification is to receive at least 22 points.

4. The condition for admission to the exam is the enrollment of at least one part of the test work, 6 laboratory works, the starting rating is at least 26 points.

5. At the exam, students perform a written test in the form of a test of 48 questions.

The correct answer to the question is estimated at 1 point.

6. The sum of starting points and points for the exam test work is converted to the exam grade according to the table:

Points:
Laboratory work + MCR + exam work

Score

100... 95	Perfectly
94... 85	Very good
84... 75	Well
74... 65	Satisfactory
64... 60	Enough
Less than 60	Disappointing
Laboratory work not completed	Not allowed

6. Additional information on the educational component

QUESTIONS FOR MODULAR CONTROL WORK

1. What are the methods used at the empirical level of research?
2. How can the main types of scientific activity of students be characterized?
3. What are the structural elements of the theory of knowledge?
4. What is the process of scientific knowledge?
5. What are the methodology, method, methodology in scientific research?
6. In what are the main forms of educational and scientific work of students?
7. What is the essence and classification of science?
8. What is the definition of "scientific knowledge: essence, objects, subjects"?
9. What is the process of scientific knowledge?
10. What is the scheme of public administration in the scientific and innovative sphere?
11. How is the choice and justification of the topic of scientific research carried out?
12. What are the methods of the theoretical level of research used?
13. How is the evaluation of the results of scientific research carried out?
14. What are scientometric bases?
15. The concept of "experiment error".
16. The concept of fractional factor experiment.
17. Types and rules for the design of experimental installations
18. The concept of "information", its essence.
19. Measuring instruments and their characteristics
20. Scientific publication, types of scientific publications.
21. Give a classification of types of tables and their characteristics.
22. The concept of a complete factor experiment.
23. To characterize the stages of students' scientific activity
24. What is the difference between primary and secondary documents?
25. Name and describe the constituent elements of the graph.

Work program of the educational component (syllabus):

Compiled by Assoc. Prof., Ph.D., Nosachova Yu.V.

Approved by the Department of E and TPP (Minutes No. 17 dated 29.05.2025)

Approved by the methodological commission of the ICF (minutes No. 11 dated 27.06.2025)