National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute"

Ecology and Technology of Plant Polymers

PROMISING AREAS OF SCIENTIFIC RESEARCH IN ENVIRONMENTAL PROTECTION. PART 2.

THEORETICAL AND EXPERIMENTAL SOLUTION OF SCIENTIFIC PROBLEMS

Work program of the educational component (Syllabus)

Details of the discipline

Higher education level	***Second (Master's)***
Field of Knowledge	*E Natural Sciences, Mathematics and Statistics*
Speciality	*E2 Ecology*
Educational program	*Environmental safety*
Status of the educational component	*Normative*
Form of study	*full-time (full-time)/mixed*
Year of preparation, semester	*1st year, spring semester*
Scope of the educational component	*4/(120)*
Semester control / control measures	*Passed*
Class schedule	*4 hours per week (1.07 hours of practical classes / 2.93 hours of laboratory classes)*
Language of instruction	*Ukrainian*
Information about the course leader / teachers	*Teacher: https://eco-paper.kpi.ua/pro-kafedru/vykladachi/nosachova-yuliya-viktorivna.html*
Course placement	*https://do.ipo.kpi.ua/course/view.php?id=2151*

Program of the educational component

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 learn and master modern knowledge*

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

According to the requirements of the educational and professional program, students after mastering the educational component must demonstrate the following program learning outcomes:

- *Know and understand the 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*

Pre-requisites and post-requisites of the educational component (place in the structural and logical scheme of education according to the relevant educational program)

The educational component "Promising areas of scientific research in environmental protection" is preceded by educational components, such as: "Promising areas of scientific research in environmental protection. Part 1. Analysis of Current Problems of Environmental Protection". The educational component "Promising areas of scientific research in environmental protection" provides educational

components "Promising areas of scientific research in environmental protection. Course work", master's thesis.

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+0yjqutc40l3qsa==
Professional Association of Ecologists of Ukraine (PAEU) - https://pae.com.ua/

EDUCATIONAL CONTENT

1. **Methods of mastering the educational component)**

Laboratory classes

In the system of professional training of students, laboratory classes occupy 73.3% of the classroom load. They lay and form the foundations for the qualification of a Master of Science 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	*Extraction of copper ions from water by electrochemical methods.*	*5*
2	*Electrochemical Extraction of Nickel Ions from Spent Nickel Plating Solutions*	*6*
3	*The use of clinoptelite to purify water from organic impurities*	*5*
4	*Using Sodium Aluminate Waste for Reagent Water Softening*	*6*
5	*The use of ferrates (VI) of alkali metals for water purification from suspended solids*	*5*
6	*Removal of petroleum products from water by magneto-sorption method*	*6*
7	*Investigation of the processes of utilization of iron-containing wastewater*	*6*
8	*Study of the processes of obtaining pressed materials from production waste*	*5*
	Total hours	*44*

Practical classes

In the system of professional training of students in this discipline, practical classes occupy 26.7% of the classroom load. They lay and form the foundations for the qualification of a Master of Science in Ecology. The content of these classes and the methodology of their conduct should ensure the development of creative activity of the individual. They develop scientific thinking and the ability to use special terminology, allow you to test knowledge, so this type of work is an important means of prompt feedback. Practical classes should perform not only cognitive and educational functions, but also contribute to the growth of students as creative workers in the field of environmental protection.

The main tasks of the cycle of practical classes:

- *to help students systematize, consolidate and deepen theoretical knowledge in the field of modern principles of forming the content of innovative activity;*
- *to teach students techniques for solving practical problems, to promote the acquisition of skills and abilities in performing calculations, graphic and other tasks;*
- *to teach them to work with scientific and reference literature and regulatory documents;*
- *to form the ability to learn independently, that is, to master the methods, ways and techniques of self-study, self-development and self-control.*

No. s/p	***Title of the topic of the practical lesson and a list of main questions (list of didactic support, references to literature and tasks on the SRS)***	***Hours***
1	**Topic 1.** *The Genesis of Science and Scientific Activity: From Protoscientific Knowledge to Modern Research [1, 4].* ***Tasks on the SRS:*** *To analyze the systems of training of scientific personnel in different countries [1 p. 35-38, 4 p. 182-187]*	***4***
2	**Topic 2.** *The process of scientific research, its characteristics and stages [1, 4].* ***Tasks on SRS****: The role of logical methods in scientific research. [4 v. 28-29]*	***3***
3	**Topic 3.** *Information support of scientific research [1, 4].* ***Tasks on the SRS:*** *To analyze the concepts and types of catalogs [2, p. 66-69, 4 p. 10-13].*	***4***
4	**Topic 1.** *Technological features of scientific research [1, 4].* ***Tasks on the SRS:*** *The influence of external factors on thinking [1, p. 5-8].*	***3***

5	***Passed***	***2***
	Just	***16***

Independent work of a student

Independent work takes 50% of the time to study the credit module, including preparation for the test. 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 p. 35-38, 4 p. 182-187]*	*14*
Chapter 2. Methodology of scientific research		
2	*The role of logical methods in scientific research. [4 v. 28-29]*	*14*
Chapter 3. Information search in scientific research		
3	*To analyze the concepts and types of catalogs [2, p. 66-69, 4, p. 10-13].*	*14*
Chapter 4. Conducting experimental research. Processing the results of experimental studies		
4	*The influence of external factors on thinking [4, p. 5-8].*	*12*
5	*Preparation for the test*	*6*
	Total hours	***60***

PROVIDING PROGRAM RESULTS WITH COMPONENTS OF THE EDUCATIONAL COMPONENT

Name of PR	***Practical classes***	***Laboratory lessons, individual task***
Know and understand fundamental and applied aspects of environmental sciences	*Practical classes 1-4*	*Laboratory work 1 - 8*

Be able to use conceptual ecological patterns in professional activities	*Practical classes 1-4*	*Laboratory work 1 - 8*
Know at the level of the latest achievements the basic concepts of natural science, sustainable development and methodology of scientific knowledge	*Practical classes 1-4*	*Laboratory work 1 - 8*
Demonstrate the ability to organize collective activities and implement complex environmental projects, taking into account available resources and time constraints	*Practical classes 1-4*	*Laboratory work 1 - 8*
Be able to clearly and unambiguously convey professional knowledge, own justifications and conclusions to specialists and the general public	*Practical classes 1-4*	*Laboratory work 1 - 8*
Demonstrate awareness of the latest environmental principles and practices	*Practical classes 1-4*	*Laboratory work 1 - 8*
Be able to use modern information resources on ecology, nature management and environmental protection	*Practical classes 1-4*	*Laboratory work 1 - 8*
Be able to assess landscape and biological diversity and analyze the consequences of anthropogenic impact on natural environments	*Practical classes 1-4*	*Laboratory work 1 - 8*
Be able to assess the potential impact of man-made objects and economic activities on the environment	*Practical classes 1-4*	*Laboratory work 1 - 8*
Apply new approaches to develop a decision-making strategy in difficult unpredictable conditions	*Practical classes 1-4*	*Laboratory work 1 - 8*
Assess environmental risks under conditions of insufficient information and conflicting requirements	*Practical classes 1-4*	*Laboratory work 1 - 8*
Choose the optimal management and/or environmental management strategy depending on environmental conditions	*Practical classes 1-4*	*Laboratory work 1 - 8*
Critically comprehend theories, principles, methods and concepts from various subject areas to solve practical problems and problems of ecology	*Practical classes 1-4*	*Laboratory work 1 - 8*
Be able to use modern methods of processing and interpreting information in carrying out innovative activities	*Practical classes 1-4*	*Laboratory work 1 - 8*
Be able to independently plan the implementation of an innovative task and formulate conclusions based on its results	*Practical classes 1-4*	*Laboratory work 1 - 8*

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	*Practical classes 1-4*	*Laboratory work 1 - 8*
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	*Practical classes 1-4*	*Laboratory work 1 - 8*

Policy and control

2. Educational Component Policy

Rules for attending classes and behavior in the classroom

Attendance at classes is a mandatory component of assessment. 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 a test. 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 academic discipline.*

Deadline and retake policy

In case of arrears in the academic 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 practice.

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

3. 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 Training	Semesters	Total kr/hours	Distribution of study time by types of classes						Semester certification
			Lecture	Practical classes	Seminar classes	Laboratory work	Computer-Practicum	SRS	
Day	Spring	4/120	-	16	-	44	-	60	Passed

The student's rating in the credit module is calculated based on 100 points.

The student's rating in the credit module consists of the points that he receives for:
- performance of 8 laboratory works;
- work in 5 practical classes.

Scoring criteria*.*
Performing laboratory work*:*
– impeccable work – 10 points;
– there are certain shortcomings in the preparation and/or performance of work – 9 – 1 points;
– absence from class without a valid reason – 0 points.

Work in practical classes:
- good preparation, active participation in the discussion of all issues and the fulfillment of tasks – 4 points;
- the answers do not provide a sufficient number of facts, examples, conclusions are not drawn, or some inaccuracies are made – 3-1 point;
- there is no active work and preparation for a practical lesson – 0 points.

Applicants who have fulfilled all the conditions for admission to the test and scored 60 or more points receive an appropriate rating score without the need to pass a semester control measure.

Applicants who have fulfilled the conditions for admission to the test, but scored less than 60 points, as well as those who want to increase their rating score, undergo a semester control measure in the form specified in the syllabus, while the semester control is estimated at 100 points.

The test *work is estimated at 100 points.*
On the test, students perform a written test in the form of a test of 34 questions. The correct answer to the question is estimated at 3 points.

The condition of the first attestation *is to obtain at least 8 points. The condition for the second attestation is to obtain at least 24 points.*

Table for converting rating points to grades.

Points: Performing laboratory work + work in practical classes Credit 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

Violation of the principles of academic integrity or moral and ethical norms of behavior	*Eliminated*

Work program of the educational component (syllabus):
Compiled by *Assoc. Prof., Ph.D., Nosachova Y.V.*
Approved *by the Department of ___E and TPP___ (Minutes No. 4 dated 8.10.2025)*
Approved *by the FAPIE Methodological Commission (Minutes No. 2 dated 15.10.2025)*