



Coursework in Perspective Research Directions in Environmental Protection
Working program of the discipline (Syllabus)

Details of the discipline

Level of higher education	<i>Second (Master's)</i>
Branch of knowledge	<i>10 Natural sciences</i>
Speciality	<i>101 Ecology</i>
Educational program	<i>Environmental safety</i>
Status of discipline	<i>Normative</i>
Form of training	<i>full-time/mixed</i>
Year of preparation, semester	<i>1 course, spring semester</i>
Volume of discipline	<i>1/(30)</i>
Semester control/ control measures	<i>Final test</i>
Schedule of classes	<i>-</i>
Language of instruction	<i>Ukrainian</i>
Information about the course /teachers	Teacher: https://eco-paper.kpi.ua/pro-kafedru/vykladachi/nosachova-yuliya-viktorivna.html
Course placement	https://do.ipk.kpi.ua/course/view.php?id=2151

Program of discipline

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

1.1. The purpose of the discipline.

The purpose of the discipline is to form the following competencies for students:

- *The ability to learn and master modern knowledge*
- *The ability to generate new ideas (creativity)*
- *The ability to search, process and analyze information from various sources*
- *The ability to develop and improve methods and technologies*
- *Awareness at the level of the latest achievements, necessary for research and/or innovative activities in the field of ecology, environmental protection and balanced nature management*
- *The ability to use the principles, methods and organizational procedures of research and/or innovation activities*
- *The ability to organize works related to the assessment of the environmental state, environmental protection and optimization of nature management, in conditions of incomplete information and conflicting requirements*
- *The ability to self-education and professional development based on innovative approaches in the field of ecology, environmental protection and balanced nature management*
- *The ability to independently develop environmental projects through the creative application of existing and the generation of new ideas*

- The ability to assess the level of negative impact of natural and anthropogenic factors of environmental hazards on the environment and humans

1.2. The main tasks of the discipline.

In accordance with the requirements of the educational, professional and educational-scientific program, students after mastering the discipline must demonstrate the results of training:

- To know and understand the fundamental and applied aspects of environmental sciences
- To be able to use conceptual environmental patterns in professional activities
- To know the basic concepts of natural science, sustainable development and methodology of scientific knowledge at the level of the latest achievements
- To demonstrate the ability to organize collective activities and implement complex environmental projects, taking into account available resources and time constraints
- To be able to communicate in a foreign language in scientific, industrial and social spheres of activity
- To demonstrate awareness of the latest principles and methods of environmental protection
- To be able to use modern methods of processing and interpretation of information in innovative activities
- To be able to use modern information resources on ecology, nature management and environmental protection
- To be able to assess landscape and biological diversity and analyze the effects of anthropogenic impact on the environment
- To be able to assess the potential impact of man-made objects and economic activities on the environment
- To apply new approaches to develop decision-making strategies in complex unpredictable conditions
- To assess environmental risks in the conditions of insufficient information and conflicting requirements
- To choose the optimal management strategy and/or nature management depending on ecological conditions
- To critically comprehend theories, principles, methods and concepts from various subject areas to solve practical problems and problems of ecology
- To be able to independently plan the implementation of an innovative task and formulate conclusions based on its results
- To master the basics of ecological engineering design and expert environmental impact assessment
- To know up-to-date approaches to the organization of environmentally cleaner production, reorganization and reconstruction of existing production from the standpoint of resource conservation, taking into account the life cycle of the product

To analyze the results of environmental control of companies, assess the engineering and technical level of environmental protection measures against the harmful effects of production

Prerequisite and requisition disciplines (place in the structural and logical scheme of training according to the relevant educational program)

The discipline "Perspective areas of scientific research in environmental protection" is preceded by academic disciplines, such as: "Chemistry with the basics of biogeochemistry", "Analytical chemistry", "Technology and equipment of atmospheric protection", "Disposal and recovery of waste", "Membrane methods of water purification", "Physicochemical bases of water purification processes by coagulation", "Sorption and ion exchange in water purification technologies", "Water purification by flotation", which were studied during training in the bachelor's degree. The discipline "Perspective directions of scientific research in environmental protection" provides the disciplines "Fundamentals of certification and statistics in ecology", "Standards and technical information in ecology", "Resource efficient and waste-free technologies", "Fundamentals of certification and statistics", master's thesis.

2. CONTENT OF EDUCATIONAL MATERIAL

Section 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.

Section 2. Methodology of scientific research

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

Section 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.

Section 4. Mathematical planning of the experiment

Planning experiments and their tasks. Basic concepts of mathematical theory of experiment planning. A complete factor experiment. Fractional factor experiment.

Section 5. Conducting experimental research

General concepts about the 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.

Section 6. Processing the results of experimental studies and their design

Statistical analysis of the results of the experiment. Determination of errors of the experiment. Detection of gross errors. The use of COMPUTER in scientific research. Preparation of the results of experimental research for publication.

Registration of the article, reports, abstracts. 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. The structure of the report on the GDR. Requirements for its design.

Educational materials and resources

Basic

1. Nosachova Yu.V., Ivanenko O.I., Radovenchyk Ya.V. *Basics of the scientific research*. Kyiv: "Condor" Publishing House, 2020. - 294 p. 130 p.
2. *Prospective directions of scientific research in environmental protection. Laboratory practicum [Electronic resource]: teaching. manual for students specialty 101 "Ecology" / KPI named after Igor Sikorskyi; edited by: T. O. Shablii, Yu. V. Nosachova, O. I. Ivanenko. – Electronic text data (1 file: 131 kbytes). – Kyiv: KPI named after Igor Sikorskyi, 2022. – 86 p.*
3. Yu.V. Nosachova *Methodological instructions for coursework from the course "Promising directions of scientific research in environmental protection" certificate No. E 02/13-09 dated 12.24.2012.*

Auxiliary

4. Partyko Z. *Fundamentals of scientific research. Dissertation preparation*. - K.: Lira-K, 2017. - 232 p.
5. Kolesnikov O.V. *Fundamentals of scientific research*. - K.: TsNL, 2019. - 144 p.
6. Anatoly Konverskyi. *Basics of methodology and organization of scientific research*. - K.: TsNL, 2019. - 350 p.
7. *State standard of Ukraine. DSTU 8302:2015 Information and documentation. Bibliographic reference. General provisions and rules of compilation.*

Information resources on the Internet

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

[Http://ukrlit.org/transliteratsiia#source=0jhqu9c+0yjquc40l3qsa==](http://ukrlit.org/transliteratsiia#source=0jhqu9c+0yjquc40l3qsa==)

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

Educational content

1. Methods of mastering the discipline (educational component)

Semester Week	Name of the stage of work	IWS Training Time
1-2	Get a theme and tasks	0,5
3-5	Selection and study of literature	5
6	Determination of the maximum surface concentration of pollutant in the surface layer from a single source	2
7	Determination of dangerous wind speed for the source of emission	0,5
7	Determination of the distance from the source of the ejection at which the surface concentration of impurities reaches the maximum value	0,5
7	Determination of the surface concentration of impurities and distance from the source at wind speed, which differs from dangerous.	1
8	Calculation of the concentration of impurities on the axis of the torch of the source of emission and the radius of the source impact zone.	2
9	Calculation of the minimum height of the source of emission	3
10	Calculation of the standards of GDV pollutant for a single source, taking into account the background concentrations of impurity	3
11	Calculation of the coefficient of mixing wastewater with water of a water object and the multiplicity of wastewater dilution	3
12	Determination of the maximum permissible concentration of suspended, toxic substances and the maximum permissible value of BSK in return waters to be discharged into a general economic or fisheries water object	3
13	Determination of the required degree of wastewater treatment to be discharged into a water bodies	2
14	Development of standards of GDS of pollutants discharged into a water object with return waters	2
15	Forecast of changes in water quality in the control creature of the water object.	1,5
16	View a course project (work) for verification	0,5
17-18	Protection of the course project (work)	0,5

Provision of program results by components of the educational component

Program results	Individual task
To know and understand the fundamental and applied aspects of environmental sciences	Selection and study of literature sources Description of methods and methods implemented in research

<i>To be able to use conceptual environmental patterns in professional activities</i>	<i>Selection and study of literature sources Selection and justification of research objects and methods Description of methods and methods implemented in research</i>
<i>To know the basic concepts of natural science, sustainable development and methodology of scientific knowledge at the level of the latest achievements</i>	<i>Selection and study of literature sources Selection and justification of research objects and methods Description of methods and methods implemented in research</i>
<i>To demonstrate the ability to organize collective activities and implement complex environmental projects, taking into account available resources and time constraints</i>	<i>Selection and justification of research objects and methods</i>
<i>To be able to communicate in a foreign language in scientific, industrial and social spheres of activity</i>	<i>Selection and justification of research objects and methods</i>
<i>To demonstrate awareness of the latest principles and methods of environmental protection</i>	<i>Selection and study of literature sources Selection and justification of research objects and methods Description of methods and methods implemented in research</i>
<i>To be able to use modern methods of processing and interpretation of information in innovative activities</i>	<i>Selection and study of literature sources Description of methods and methods implemented in research Protection of term paper</i>
<i>To be able to use modern information resources on ecology, nature management and environmental protection</i>	<i>Selection and study of literature sources Selection and justification of research objects and methods</i>
<i>To be able to assess landscape and biological diversity and analyze the effects of anthropogenic impact on the environment</i>	<i>Selection and study of literature sources Selection and justification of research objects and methods</i>
<i>To be able to assess the potential impact of man-made objects and economic activities on the environment</i>	<i>Selection and study of literature sources Selection and justification of research objects and methods</i>
<i>To apply new approaches to develop decision-making strategies in complex unpredictable conditions</i>	<i>Description of methods and methods implemented in research</i>
<i>To assess environmental risks in the conditions of insufficient information and conflicting requirements</i>	<i>Description of methods and methods implemented in research</i>
<i>To choose the optimal management strategy and/or nature management depending on ecological conditions</i>	<i>Selection and justification of research objects and methods Protection of term paper</i>
<i>To critically comprehend theories, principles, methods and concepts from various subject areas to solve practical problems and problems of ecology</i>	<i>Conducting experimental research Calculation of the obtained results</i>
<i>To be able to independently plan the implementation of an innovative task and formulate conclusions based on its results</i>	<i>Selection and justification of research objects and methods Conducting experimental research</i>
<i>To master the basics of ecological engineering design and expert environmental impact assessment</i>	<i>Conducting experimental research Calculation of the obtained results Issuance of an explanatory note</i>
<i>To know up-to-date approaches to the organization of environmentally cleaner production, reorganization and reconstruction of existing production from the standpoint of resource conservation, taking into account the life cycle of the product</i>	<i>Selection and study of literature sources Description of methods and methods implemented in research</i>
<i>To analyze the results of environmental control of companies, assess the engineering and technical level of environmental protection measures against the harmful effects of production</i>	<i>Conducting experimental research Calculation of the obtained results Issuance of an explanatory note Protection of term paper</i>

List of topics (source data variants)

1. Wastewater treatment in the fishing industry.
2. Water treatment for the needs of the urban-type settlement.
3. Preparation of drinking water from underground water sources.
4. Disposal of solid household waste.
5. Ecological fuel based on coal enrichment waste.

6. Membrane water purification from biphenol-A.
7. Hybrid silica coatings for environmentally friendly anticorrosive protection of aluminum.
8. Removal of sulfates from wastewater by reagent method.
9. Complex formation in the purification of water from fluorides.
10. Coal and mineral sorbents and their modification.
11. Modern methods of biological wastewater treatment.
12. Coal and mineral sorbents and their modification.
13. Purification of water from nitrates by reagent-energized ultrafiltration.
14. Treatment of wastewater of animal complexes.
15. Treatment of wastewater of electroplating enterprises from chromium compounds.
16. Features of cleaning the effluent of the meat processing plant.
17. Wastewater treatment of margarine production.
18. Wastewater treatment of landfills of municipal waste.
19. System of collection and disposal of solid household waste.
20. Development of technology for cleaning wastewater from washing cars.
21. Technology of cleaning of yeast plant effluent.
22. Cleaning of casting waters from the territory of cities.
23. Ecological fuel on the basis of highly concentrated suspensions of brown coal.
24. Stabilization treatment of water for water-fighting systems.
25. Closed recycling cooling systems.
26. Cleaning of municipal effluents.

The source data for 15 and 26 variants is given in Appendix A.

Topic names and source data are specified for each student of the group when forming the final list and purposefully, subject to the requirements of interested enterprises and organizations.

Rating system for evaluating learning outcomes

Rating assessment of coursework 100-point and has 2 components: 1 component - assessment of the current state of the problem; substantiation and selection of theoretical and experimental methods of research of the tasks; scientific analysis and generalization of the actual material; the use of mathematical methods of planning an experiment; 2 components of the ability to adequately present the work in the protection of coursework. The size of the scale of components is equal to 20 points each.

Regulations on the rating system for assessing the success of students from the course work of the credit module "On the promising directions of scientific research. Coursework" is given in Appendix B.

Methodical recommendations

Coursework consists of a report on coursework and illustrative material to protect the work.

Reports on coursework, as well as scientific abstracts, coursework and diploma papers include the following general requirements: clarity and logical sequence of material presentation; persuasiveness of argumentation; brevity and accuracy of formulations, including the possibility of ambiguous interpretations; specificity of presentation of the results of work; validity of recommendations and suggestions.

The report on coursework should contain the following structural elements: title page, abstract, content, introduction, essence of the report; conclusions, list of references, annexes.

To provide students with methodological literature, methodical instructions for the implementation of coursework have been developed [6], recommended by the Academic Council of the IHF.

Politics and control

3. Policy of discipline (educational component)

Rules for attending classes and behavior in classes

Students are obliged to take an active part in the educational process, not to be late for classes and not 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

Semester certification is carried out in the form of protection of course work. To assess the results of training, a 100-point rating system and a university scale are used.

Rules for assigning incentive and penalty points

-incentive points within the discipline are not provided for

-penalty points within the discipline are not provided.

Deadline and overlay policy

In case of debts in the discipline or any force majeure circumstances, students should contact the teacher through accessible (provided by the teacher) communication channels to solve problematic issues and coordinate the 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. Invalid hints and write-offs when writing tests, conducting classes; passing the credit for another student; copying of materials protected by the copyright system without the permission of the author of the work.

The policies 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>

Policy of academic behavior and ethics

Students should be tolerant, respect the opinion of others, object to formulate in the correct form, 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>

4. Types of control and rating system for assessing learning outcomes (RCOs)

The rating assessment on coursework has two components. The first (starter) characterizes the student's work on course design and its result – the quality of the explanatory note and graphic material. The second component characterizes the quality of the student's defense of coursework.

The size of the starting component scale is 40 points, and the component of protection is 60 points.

1. Starting component:

- timeliness of the schedule of work on course design – 5-3 points;
- assessment of the current state of the problem – 12-7 points;
- substantiation and selection of theoretical and experimental methods of research of the tasks – 10-6 points;
- scientific analysis and generalization of the actual material – 6-4 points;
- use of mathematical methods of planning the experiment – 7-4 points.

2. Component of course work protection:

- quality of the report – 10-6 points;
- degree of ownership of the material – 15-9 points;
- the degree of justification of the decisions made – 15-9 points;
- ability to defend your opinion – 20-12 points.

3. The sum of the points of the two components is transferred to the scoring assessment according to the table:

Points	Score
Starting component + protection component	
100... 95	Perfectly
94... 85	Very good
84... 75	Well
74... 65	Satisfactory
64... 60	Enough
Less than 60	Disappointing
Coursework is not allowed to be protected	Not allowed

5. Additional information on the discipline (educational component)

Table A.1. Initial data for the development of methods for the treatment of municipal wastewater.

Indicator	Metric Value
Consumption	40 000 m ³ /day
Hanging substances	280 mg/dm ³
BSK _{full}	283 mg/dm ³
Fat content and floating organic impurities	Up to 22 mg/dm ³
PH reaction	7,3
Chemical oxygen consumption	677 mg/dm ³
Ammonium nitrogen	29.6 mg/dm ³
Phosphates	19.3 mg/dm ³
Chlorides	119.5 mg/dm ³
Sulphates	81.95 mg/dm ³
Iron	3.15 mg/dm ³
Water consumption	10000 m ³ /day

Table A.2. Purified water requirements

№	Indicators of wastewater quality	Requirements for purified water	Background concentration
1	Temperature, °C	≤5	14,4
2	Ph	6,5 – 9,0	8,1
3	Dry residue, mg/dm ³	≤1000	1000
4	Dissolved oxygen, mg/dm ³	≥6	5,5
5	Concentration of suspended substances, mg/dm ³	≤0,25-0,75	24,8
6	Petroleum products, mg/dm ³	≤0,85	0,55
7	Chemical oxygen consumption, mg/dm ³	80	40
8	Full BSC, mg/dm ³	15	6,5
9	Sulfates, mg/dm ³	100	120,1

10	Phosphates, mg/dm ³	0,1 - 0,2	2,4
11	Chlorides, mg/dm ³	≤350	34,9
12	Ammonium nitrogen, mg/dm ³	0,2-0,6	1,7
13	Total iron content, mg/dm ³	0,50	0,77
14	Aluminum, mg/dm ³	0,90	0,84

Table A.3. Characteristics of wastewater and requirements for treated water of electroplating industries

<i>N^o</i>	<i>Name of the indicator</i>	<i>Characteristics of waste water</i>	<i>Requirements for purified water</i>
	<i>Flow rate, m³/day</i>	<i>10</i>	
<i>1</i>	<i>pH</i>	<i>5,5 - 7</i>	<i>6,5 - 9</i>
<i>2</i>	<i>Content, mg/dm³: hanging p-n</i>	<i>15</i>	<i>350</i>
<i>3</i>	<i>Nitrates</i>	<i>15</i>	<i>-</i>
<i>4</i>	<i>Sulphates</i>	<i>30</i>	<i>500</i>
<i>5</i>	<i>Chlorides</i>	<i>45</i>	<i>350</i>
<i>6</i>	<i>iron</i>	<i>3</i>	<i>5</i>
<i>7</i>	<i>zinc</i>	<i>5</i>	<i>0,3</i>
<i>8</i>	<i>chromium(III)</i>	<i>10</i>	<i>1</i>
<i>9</i>	<i>chromium(VI)</i>	<i>100</i>	<i>0,1</i>
<i>10</i>	<i>Mineralization</i>	<i>150</i>	<i>1000</i>

Work program of the discipline (syllabus):

Compiled assoc., Ph.D., Nosachova Yu.V.

Approved by the Department E and TRP (protocol No. 14 of 08.06.2022)

It was approved by the IHF Dich Commission (Protocol No. 10 of 24. 06.2022)