Національний технічний університет України
«КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ
імені ІГОРЯ СІКОРСЬКОГО»

Ecology and Technology of Plant Polymers

COURSEWORK IN PERSPECTIVE RESEARCH DIRECTIONS IN ENVIRONMENTAL PROTECTION

Work program of the discipline (Syllabus)

Details of the discipline

Level of higher education	***Second (Master's)***
Field of knowledge	*10 Natural sciences*
Speciality	*101 Ecology*
Educational program	*Environmental safety*
Discipline status	*Normative*
Form of study	*full-time (full-time)/mixed*
Year of preparation, semester	*1 year, spring semester*
Scope of discipline	*1/(30)*
Semester control / control measures	*Passed*
Timetable	-
Language of instruction	*Ukrainian*
Information about Course Leader / Instructors	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*

The program of the discipline

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

1.1. The purpose of the discipline.

The purpose of the discipline 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 of the latest achievements necessary for research and/or innovation activities in the field of ecology, environmental protection and sustainable use of natural resources;*
- *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 self-education and advanced training based on innovative approaches in the field of ecology, environmental protection and sustainable use of natural resources;*
- *Ability to independently develop environmental projects through the creative application of existing and the generation of new ideas;*
- *Ability to assess the level of negative impact of natural and anthropogenic factors of environmental hazard on the environment and humans*

1.2. The main tasks of the discipline.

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

- *Know and understand the fundamental and applied aspects of environmental sciences;*
- *Be able to use conceptual ecological patterns in professional activities*
- *Know the basic concepts of natural science, sustainable development and methodology of scientific knowledge at the level of the latest achievements*
- *Demonstrate the ability to organize collective activities and implement complex environmental projects, taking into account available resources and time constraints*
- *Be able to convey clearly and unambiguously professional knowledge, own justifications and conclusions to specialists and the general public.*
- *Demonstrate awareness of the latest principles and methods of environmental protection*
- *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 complex unpredictable environments*
- *Assess environmental risks in the face of insufficient information and conflicting requirements*
- *Choose the optimal strategy for managing and/or using natural resources 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 interpretation of information when conducting innovative activities*
- *Be able to independently plan the implementation of an innovative task and formulate conclusions based on its results*
- *Possess the basics of environmental engineering design and environmental expert assessment of environmental impact*
- *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*
- *Analyze the results of environmental control of enterprises' activities, assess the engineering and technical level of environmental protection from the harmful effects of production*

Prerequisites and post-requisites of the discipline (place in the structural and logical scheme of training in the relevant educational program)

The discipline "Promising areas of scientific research in environmental protection" is preceded by the following disciplines: "Chemistry with the basics of biogeochemistry", "Analytical chemistry", "Technology and equipment for atmospheric protection", "Waste disposal and recovery", "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 undergraduate studies. The academic discipline "Promising Areas 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 THE TRAINING MATERIAL

Chapter 1. General information about the concept of science.

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

Chapter 2. Research Methodology

Methods of scientific research. Methods of empirical level of 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 retrieval 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 design of the experiment

Experiment planning and its tasks. Basic Concepts of the Mathematical Theory of Experiment Design. Full Factor Experiment. Fractional factor experiment.

Chapter 5. Conducting experimental research

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

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

Statistical analysis of the results of the experiment. Determination of experiment errors. Detection of gross errors. Use of computers in scientific research. Preparation of experimental research results for publication. Design of an article, report, abstract. Depositing 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 design.

Training Materials & Resources

Basic

1. Nosachova Yu.V., Ivanenko O.I., Radovenchyk Y.V. Osnovy naukovyi doslidzhennia [Fundamentals of scientific research]. Kyiv: Condor Publishing House, 2020. – 294 p. 130 p.

2. Promising areas of scientific research in environmental protection. Laboratory practicum. Helps. for students. specialty 101 "Ecology" / KPI them. Igor Sikorsky; compiled by T. O. Shabliy, Y. V. Nosachova, O. I. Ivanenko. – Electronic text data (1 file: 131 KB). – Kyiv: KPI them. Igor Sikorsky, 2022. – 86 p.

3. Nosachova Y.V. Methodical instructions for the implementation of course work on the course "Perspective directions of scientific research in environmental protection" No certificate E 02/13-09 dated 24.12.2012.

Secondary

4. Partyko Z. Osnovy naukovyi doslidzhennia [Fundamentals of scientific research]. Preparation of the dissertation. Kyiv: Lira-K, 2017. – 232 p.

5. Kolesnikov O. V. Osnovy naukovyi doslidzhennia [Fundamentals of scientific research]. Kyiv: CNL, 2019. – 144 p.

6. Anatoly Konversky. Fundamentals of methodology and organization of scientific research. Kyiv: CNL, 2019. – 350 p.

7. State Standard of Ukraine. DSTU 8302:2015 Information and documentation. Bibliographic reference. General Provisions and Rules of Drafting.

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 discipline (educational component)

Semester Week	***Name of the stage of work***	***SRS Study Time***
1-2	*Getting a Topic and Assignment*	*0,5*
3-5	*Selection and study of literature sources*	*5*
6-8	*Selection and justification of objects and methods of research*	*4*
9	*Description of methods and methods implemented in research*	*1*
10-13	*Conducting experimental research*	*10,5*
14	*Calculation of the results obtained*	*4*
15	*Preparation of an explanatory note*	*4*
16	*Submission of coursework for review*	*0,5*
17-18	*Coursework defense*	*0,5*

Provision of program results by the components of the educational component

Name of PR	***Individual task***
Know and understand the fundamental and applied aspects of the environmental sciences	*Selection and study of literature sources* *Description of methods and methods implemented in research*

Be able to use conceptual ecological patterns in professional activities	*Selection and study of literature sources* *Selection and justification of objects and methods of research* *Description of methods and methods implemented in research*
Know the basic concepts of natural science, sustainable development and methodology of scientific knowledge at the level of the latest achievements	*Selection and study of literature sources* *Selection and justification of objects and methods of research* *Description of methods and methods implemented in research*
Demonstrate the ability to organize collective activities and implement complex environmental projects, taking into account available resources and time constraints	*Selection and justification of objects and methods of research*
Be able to clearly and unambiguously convey professional knowledge, own justifications and conclusions to specialists and the general public	*Selection and justification of objects and methods of research*
Demonstrate awareness of the latest principles and methods of environmental protection	*Selection and study of literature sources* *Selection and justification of objects and methods of research* *Description of methods and methods implemented in research*
Be able to use modern information resources on ecology, nature management and environmental protection	*Selection and study of literature sources* *Description of methods and methods implemented in research* *Coursework defense*
Be able to assess landscape and biological diversity and analyze the consequences of anthropogenic impact on natural environments	*Selection and study of literature sources* *Selection and justification of objects and methods of research*
Be able to assess the potential impact of man-made objects and economic activities on the environment	*Selection and study of literature sources* *Selection and justification of objects and methods of research*
Apply new approaches to develop a decision-making strategy in complex unpredictable environments	*Selection and study of literature sources* *Selection and justification of objects and methods of research*
Assess environmental risks in the face of insufficient information and conflicting requirements	*Description of methods and methods implemented in research*
Choose the optimal strategy for managing and/or using natural resources depending on environmental conditions	*Description of methods and methods implemented in research*
Critically comprehend theories, principles, methods and concepts from various subject areas to solve practical problems and problems of ecology	*Selection and justification of objects and methods of research* *Coursework defense*

Be able to use modern methods of processing and interpretation of information when conducting innovative activities	*Conducting experimental research* *Calculation of the results obtained*
Possess the basics of environmental engineering design and environmental expert assessment of environmental impact	*Selection and justification of objects and methods of research* *Conducting experimental research*
Be able to independently plan the implementation of an innovative task and formulate conclusions based on its results	*Conducting experimental research* *Calculation of the results obtained* *Preparation of an explanatory note*
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	*Selection and study of literature sources* *Description of methods and methods implemented in research*
Analyze the results of environmental control of enterprises' activities, assess the engineering and technical level of environmental protection from the harmful effects of production	*Conducting experimental research* *Calculation of the results obtained* *Preparation of an explanatory note* *Coursework defense*

List of topics (variants of initial data)

1. *Wastewater treatment in the fish processing industry.*
2. *Water treatment for the needs of an urban-type settlement.*
3. *Preparation of drinking water from underground water supply sources.*
4. *Disposal of solid household waste.*
5. *Eco-friendly fuel based on coal beneficiation waste.*
6. *Membrane purification of water from biphenol-A.*
7. *Hybrid silica coatings for environmentally friendly anti-corrosion protection of aluminum.*
8. *Removal of sulfates from wastewater by reagent method.*
9. *Complexation in water purification 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-enhanced ultrafiltration.*
14. *Wastewater treatment of animal complexes.*
15. *Treatment of wastewater from electroplating enterprises from chromium compounds.*
16. *Features of wastewater treatment of a meat processing plant.*
17. *Wastewater treatment of margarine production.*
18. *Wastewater treatment of municipal waste landfills.*
19. *Solid waste collection and disposal system.*
20. *Development of a technology for wastewater treatment from car washes.*
21. *Yeast plant wastewater treatment technology.*
22. *Treatment of storm water from the territory of cities.*
23. *Environmentally friendly fuel based on highly concentrated lignite suspensions.*
24. *Stabilization treatment of water for water circulation systems.*
25. *Closed-loop recirculating cooling systems.*
26. *Treatment of municipal wastewater.*

The initial data for options 15 and 26 are given in Appendix A.

The names of the topics and the initial data are specified for each student of the group when forming the final list of names and purposefully, taking into account the requirements of interested enterprises and organizations.

Rating system for assessing learning outcomes

The rating score for the course work is 100-point and has 2 components: 1 component - assessment of the current state of the problem; substantiation and selection of theoretical and experimental methods for the study of the tasks; scientific analysis and generalization of factual material; use of mathematical methods of experiment design; Component 2 of the ability to adequately present the work when defending a term paper. The size of the scale of components is 20 points each.

Regulations on the rating system for assessing students' performance in the course work of the credit module "Promising areas of scientific research. Coursework" is given in Appendix B.

Methodical recommendations

The coursework consists of a coursework report and illustrative material to defend the work.

The following general requirements are imposed on reports on term papers, as well as scientific essays, term papers and theses: clarity and logical sequence of presentation of the material; persuasiveness of argumentation; brevity and accuracy of wording, including the possibility of ambiguous interpretations; specificity of the presentation of the results of the work; validity of recommendations and proposals.

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

To provide students with methodological literature, methodological guidelines for the implementation of course work [3] recommended by the Academic Council of the IHF have been developed.

Policy & Control

3. Academic discipline policy (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 valid reason, not to interfere with the teacher's 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 a defense of a term paper. To assess learning outcomes, a 100-point rating system and a university scale are used.

Rules for assigning incentive and penalty points

- *incentive points within the academic discipline are not provided*
- *There are no penalty points within the academic discipline.*

Deadlines and retakes policy

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

Academic Integrity Policy

Plagiarism and other forms of dishonest work are unacceptable. Plagiarism includes the lack of references when using printed and electronic materials, quotes, opinions of other authors. Inadmissible hints and cheating when writing tests, conducting classes; passing a test for another student; copying copyrighted material 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 opinion 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

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

The rating grade for a term paper has two components. The first (starting) one 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 the term paper.

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

1. Starting component:

– timeliness of the work schedule 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 factual material – 6-4 points;

– use of mathematical methods of experiment design – 7-4 points.

2. Component of the coursework defense:

– quality of the report – 10-6 points;

– degree of mastery of the material – 15-9 points;

– the degree of justification of the decisions made – 15-9 points;

– ability to defend one's opinion – 20-12 points.

3. The sum of the points of the two components is converted to the credit grade 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 admitted to the defense	*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	*Indicator value*
Consumption	*40 000 m3/day*
Suspended solids	*280 mg/dm3*
BOD_{full}	*283 mg/dm3*
Content of fats and floating organic impurities	*Up to 22 mg/dm3*
pH reaction	*7,3*
Chemical oxygen consumption	*677 mg/dm3*
Ammonium nitrogen	*29.6 mg/dm3*
Phosphates	*19.3 mg/dm3*
Chlorides	*119.5 mg/dm3*
Sulphates	*81.95 mg/dm3*
Iron	*3.15 mg/dm3*
Water consumption	*10000 m3/day*

Table A.2. Purified Water Requirements

№	*Wastewater Quality Indicators*	*Purified Water Requirements*	*Background Concentration*

1	Temperature,◦C	≤5	14,4
2	Ph	6,5 – 9,0	8,1
3	Dry residue, mg/dm3	≤1000	1000
4	Dissolved oxygen, mg/dm3	≥6	5,5
5	Concentration of suspended solids, mg/dm3	≤ 0,25-0,75	24,8
6	Petroleum products, mg/dm3	≤0,85	0,55
7	Chemical oxygen consumption, mg/dm3	80	40
8	BODfull, mg/dm3	15	6,5
9	Sulfates, mg/dm3	100	120,1
10	Phosphates, mg/dm3	0,1 - 0,2	2,4
11	Chlorides, mg/dm3	≤350	34,9
12	Ammonium nitrogen, mg/dm3	0,2-0,6	1,7
13	Total iron content, mg/dm3	0,50	0,77
14	Aluminum, mg/dm3	0,90	0,84

Table A.3. Characteristics of wastewater and requirements for purified water of galvanic production facilities

№	Indicator name	Characteristics of wastewater	Purified Water Requirements
	Flow rate, m3/day	10	
1	pH	5,5 - 7	6,5 - 9
2	Content, mg/dm3: suspended p-s	15	350
3	Nitrates	15	-
4	Sulphates	30	500
5	Chlorides	45	350
6	iron	3	5
7	zinc	5	0,3
8	Chromium(III)	10	1
9	Chromium(VI)	100	0,1
10	Mineralization	150	1000

Work program of the discipline (syllabus):
Compiled by *Assoc. Prof., Ph.D., Nosachova Y.V.*
Approved *by the Department of ___E and TRP___ (Minutes No. 17 dated 23.05.2024)*
Approved *by the IHF Methodological Commission (Minutes No. 11 dated 06/28/2024)*