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

Department of Ecology and Technology of Plant Polymers

Technoecology

Work program of the academic discipline (Silabus)

Details of the discipline	
Level of higher education	***First (educational and professional)***
Field of expertise	*10 Natural sciences*
Speciality	*101 Ecology*
Educational program	*Environmental safety*
Status of the discipline	*Required*
Form of study	*full-time/distance/mixed*
Year of study, semester	*4th year / fall semester*
Scope of the discipline	*4.5 ECTS credits (135 hours)*
Semester control / control measures	*Examination*
Class schedule	*3 lecture hours per week*
Language of instruction	*Ukrainian*
Information about course leader / teachers	Lecturer: https://eco-paper.kpi.ua/pro-kafedru/vykladachi/ivanenko-olena-ivanivna.html
Placement of the course	*https://do.ipo.kpi.ua*

Program of the discipline

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

Modern industry lays the material foundation for human life. Given the rapid growth of the population and the increasing demand for goods and services provided by industry, it is clear that the industrial complex is a leader in terms of the intensity of its environmental impact. The impact of industry on the environment depends on the nature of its territorial location, the amount of raw materials and energy it consumes, the ability to recycle waste and the degree of completeness of energy production cycles.

Ukraine is one of the countries with a high level of negative environmental impacts of production activities, and therefore the problem of environmental protection and rational use of natural resources needs to be addressed as a matter of priority.

Outdated production technologies and equipment, a high concentration of environmentally hazardous industrial enterprises, low levels of operation of gas and water treatment facilities, an insignificant percentage of waste utilization and recovery, and the lack of reliable legal and economic mechanisms that would stimulate the development of environmentally friendly technologies and environmental protection systems are the main reasons that have led to the threatening state of our country's environment.

To prevent the negative effects of human economic activity and improve the environment, it is necessary to constantly improve both production technologies and implement the latest ways to protect the environment.

The subject of the discipline "Technoecology" *is the solution of environmental problems in such major industries as the nitrogen fertilizer industry, phosphate and potash fertilizer industry, pulp and paper, food and agriculture, fuel and energy, metallurgy, oil refining and construction industries.*

To a large extent, the solution to this problem will be determined by the level of training of specialists working in the field of environmental protection, including institutions of state environmental safety management, scientific institutions and organizations, and enterprises.

To successfully address environmental protection and conservation, specialists must be fluent in information about the main production facilities of the chemical, food, mining, machine-building, oil refining and construction industries, and have a good knowledge of modern methods and technologies for wastewater treatment, gaseous emissions and solid waste disposal. Without such knowledge, it is difficult to make a correct assessment of the effectiveness of existing environmental technologies in industry and to choose areas for the reconstruction of outdated production lines.

Objective of the discipline "Technoecology"

The purpose of this discipline is to form a set of modern knowledge of the main raw materials of domestic plants of Ukraine and their competitiveness, hardware design and the basics of the theory of chemical processes of production, technological schemes of production, modern methods of processing liquid, gaseous and solid waste.

In accordance with the goal, bachelor's training requires strengthening the competencies formed by students:

- *Knowledge and understanding of the theoretical foundations of ecology, environmental protection and sustainable use of natural resources;*
- *Ability to assess the impact of technological processes on the environment and identify environmental risks associated with production activities;*
- *Ability to master international and domestic experience in solving regional and transboundary environmental problems;*
- *Ability to participate in the management of environmental actions and/or environmental projects;*
- *Ability to improve, design, implement and operate technologies and equipment for the treatment and processing of exhaust gases, wastewater and solid waste;*
- *Ability to distinguish between technological processes of production, identify sources and ways of entering the environment of harmful components, assess their impact on human health and environmental quality.*

According to the requirements of the program of the discipline ***"Technoecology"****, , students must demonstrate the following program learning outcomes after completing it:*

- *Demonstrate an understanding of the basic principles of environmental management and/or environmental projects;*
- *Understand the basic concepts, theoretical and practical problems in the field of natural sciences that are necessary for analyzing and making decisions in the field of ecology, environmental protection and optimal nature management;*
- *Apply the management principles on which the environmental safety system is based;*
- *Identify factors that determine the formation of landscape and biological diversity;*
- *Solve problems in the field of environmental protection using generally accepted and/or standard approaches and international and domestic experience;*
- *Be able to predict the impact of technological processes and production on the environment;*

– *Participate in the development and implementation of projects aimed at the optimal management and treatment of industrial and municipal waste;*

– *Be able to explain the social, economic, and political implications of environmental projects;*

– *Improve professional skills through continuing education and self-education;*

– *Participate in the development of projects and practical recommendations for environmental protection;*

– *Conduct laboratory tests using modern instruments, ensure sufficient measurement accuracy and reliability of the results, and process the results;*

– *To assess the state of the environment, determine the level of impact of the enterprise (production) on the environment, and identify the main environmental pollutants of the enterprise (production).*

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

*The study of **the** discipline "**Technoecology"** is based on the principles of integrating the various knowledge gained by students during their bachelor's degree in natural science and engineering: "Human Ecology", "Fundamentals of Design and Construction. Course Project", "Environmental Monitoring. Part 2".*

*The discipline **"Technoecology"** is the fundamental basis for the study of the discipline "Environmental and Natural-Technological Safety" and ensures the implementation of the bachelor's project.*

3. Content of the discipline "Technoecology"

Section 1. Environmental safety of the mineral fertilizer industry.

Topic 1: Potash fertilizer production technology. Utilization of potash production wastes.

Topic 2. Environmental problems of phosphorus and phosphoric acid production and methods of their solution.

Topic 3: Phosphate fertilizer production.

Topic 4. Environmentally friendly production of hydrogen, nitrogen and ammonia.

Topic 5. Ammonia fertilizer technology.

Section 2. Environmental safety of the dye and fiber industry.

Topic 1: Fundamentals of chemical fiber production.

Topic 2. Characterization of wastewater from the production of artificial and synthetic fibers and methods of their treatment.

Topic 3: Treatment of wastewater from the production and use of synthetic dyes.

Section 3. Wastewater treatment and recycling of food industry waste.

Topic 1: Basics of technology and processing of sugar production waste.

Topic 2. Environmental technologies in sugar production.

Topic 3: Fundamentals of food alcohol production technology.

Topic 4. Ecologization of food alcohol production.

Chapter 4. Environmental problems of pulp, paper and cardboard production. Ways to solve them.

Topic 1: Pulp and paper wastewater treatment and utilization of valuable products from wastewater.

Section 5. Environmental protection in the use of pesticides.

Topic 1: Environmental protection in the use of pesticides.

Chapter 6. Environmental problems of the energy sector and ways to solve them.

Topic 1: Basic concepts and processes of reactor technology.

Topic 2. Water treatment and water purification during NPP operation. Liquid radioactive waste disposal.

Topic 3: Ways to manage gaseous and solid radioactive waste.

Topic 4. Environmental pollution related to coal mining

Topic 5. Environmental issues arising from coal mining and processing.

Topic 6. Environmental pollution by TPPs and its protection.

Section 7. Impact of metallurgical enterprises on the environment. Environmental protection.

Topic 1: Cast iron production technology. Environmental problems and their solutions.

Topic 2. Coke production. Use of coke products.

Topic 3: Steel production and its hardware design.

Topic 4. Generation and processing of wastewater from metallurgical enterprises. Use of ferrous metallurgy waste.

Topic 5. Technology of ferrosilicon and ferromanganese production.

Section 8. Oil refining industry. Environmental problems of the industry.

Topic 1: Oil production and refining methods.

Topic 2. Environmental safety of oil and oil products refining.

Topic 3. Generation and utilization of gaseous and solid waste from oil refineries.

Chapter 9. Construction industry. Impact on the environment.

Topic 1: Production technology of binding materials.

Topic 2. Technology of manufacturing concrete and reinforced concrete products.

Topic 3: Production of glass and glass products for technical purposes. Impact of the construction industry on the environment.

Training materials and resources

Basic literature

1. *Technoecology: a textbook / O.I. Ivanenko, Y.V. Nosacheva. Kyiv: Condor Publishing House, 2017. 294 c. ISBN 978-617-7582-05-1*
2. *Technoecology: a textbook / O.I. Ivanenko, Yu.V Nosachova, V.A. Ovsyankina, V.V. Vember. Kyiv: "Condor" Publishing House, 2022. 388 p. ISBN 978-617-8052-71-3*

Supporting literature

3. *Klymenko M.O. Zalesky I.I. Technoecology: a textbook. Kherson: ALDI PLUS, 2017. 348 c.*
4. *Malyovanyi M.S., Boholyubov V.M., Shanina T.P., Shmandiy V.M., Safranov T.A. Technoecology: textbook / Edited by M.S. Malyovanyi. Lviv: Lviv Polytechnic National University, 2014. 616 c.*
5. *Voitsitsky A.P., Dubrovsky V.P., Bogolyubov V.M. Technoecology: textbook / edited by V.M. Bogolyubov. Kyiv: Agrarian Education, 2009. 533 c.*
6. *Petruk V.G. Modern environmentally friendly technologies for disinfection of unusable pesticides - Vinnytsia: Universum-Vinnytsia, 2003. - 254 p.*

7. *Omelchenko V., Markevych K. Nuclear Energy in the World and Ukraine: Current Status and Development Prospects. Kyiv: Razumkov Center, 2015. 26 c.*
8. *Ostapchuk M.V., Rybak A.I. System of technologies (by types of activity): Study guide. - K.: TSUL, 2003. - 888 p.*

Information resources on the Internet

9. Ministry of Environmental Protection and Natural Resources of Ukraine / [Electronic resource] - Access mode: https://mepr.gov.ua/.
10. Industrial ecology. Community of environmentalists / [Electronic resource]. - Access mode: http://www.eco.com.ua/.
11. Professional Association of Ecologists of Ukraine / [Electronic resource] - Access mode: https://paeu.com.ua/.
12. Denysenko Scientific and Technical Library / [Electronic resource] - Access mode: https://library.kpi.ua.
13. Vernadsky National Library / [Electronic resource] - Access mode: http://www.nbuv.gov.ua/.
14. Electronic archive of scientific and educational materials of Igor Sikorsky Kyiv Polytechnic Institute / [Electronic resource]: https://ela.kpi.ua/.

Educational content

5. Methods of mastering the discipline

Lecture classes

Lecture classes are aimed at:

- *providing up-to-date, holistic, interdependent knowledge in **the** discipline of **Technoecology**, **the** level of which is determined by the target setting for each specific topic;*
- *Ensuring that students work together with the teacher during the lecture;*
- *fostering students' professional and business skills and developing their independent creative thinking;*
- *developing the necessary interest in students and determining the direction for independent work;*
- *determining the current level of scientific development in the field of modern methods of processing liquid, gaseous and solid waste from industrial enterprises;*
- *displaying the methodological processing of the material (highlighting the main points, conclusions,*
  recommendations, their clear and adequate formulation)

-use of visual materials for demonstration, combining them, if possible, with the demonstration of results and samples;

-presenting the research materials in clear and high-quality language, observing structural and logical connections, explaining all newly introduced terms and concepts;

- *accessibility to the audience.*

No. s/n	***Title of the lecture topic and a list of main issues (list of didactic tools, references to literature and assignments for IWS)***	***Hours***
1	***Potash fertilizer production technology. Utilization of potash production waste.*** *Properties and uses of potash fertilizers. Sources of potash raw materials. Mechanical beneficiation of potash ores. Processing of sylvinites by flotation. Processing of sylvinite-carnallite ores by the galvanic method. Utilization of potash production wastes.* *References: [1] pp. 204-206, [1] pp. 215-218.* *IWS: Production of chlorine-free potash fertilizers.*	*2*

	References: [1] pp. 212-215, [3-5, 8]	
2	***Environmental problems in the production of phosphorus, phosphoric acid, phosphate fertilizers and methods of their solution.*** *Sources of phosphorus raw materials. Basics and processing of phosphoric acid and phosphate fertilizer production wastes.* *References: [1] pp. 190-203.* *IWS: Waste from phosphorus production.* *References: [3-5, 8]*	*2*
3	***Environmentally friendly production of hydrogen, nitrogen and ammonia.*** *Production of process gas for ammonia synthesis. Ammonia synthesis.* *References: [1] pp. 170-184.* *IWS: Production of nitric acid. Removal of nitrous gases from nitrogen oxides.* *References: [3-5, 8]*	*2*
4	***Ammonia fertilizer technology.*** *Production of ammonium nitrate, urea and ammonium sulphate.* *References: [1] pp. 184-189.* *IWS: Production of liquid ammonia fertilizers.* *References: [3-5, 8]*	*2*
	Writing a module test paper	*0,4*
5	***Fundamentals of chemical fiber production. Characterization of wastewater from the production of artificial and synthetic fibers and methods of their treatment.*** *Classification of chemical fibers. Fundamentals of obtaining artificial fibers. Production of viscose fibers and cellophane. Technology of acetate fiber production. Production of synthetic fibers. Production of polyamide fiber. Wastewater treatment of artificial and synthetic fiber enterprises.* *References: [1] pp. 233-246.* *IWS: Features of obtaining artificial and synthetic fibers.* *References: [3-5, 8]*	*2*
6	***Treatment of wastewater from the production and use of synthetic dyes.*** *Technical classification of dyes. Waste water composition. Methods of wastewater treatment from dyes.* *References: [1] pp. 218-227, 228-232.* *IWS: Environmental impact of dyes and related contaminants.* *References: [1] pp. 227-228, [3-5, 8]*	*2*
7	***Basics of technology and processing of sugar production waste. Environmental technologies in sugar production.*** *Basics of sugar production technology. Waste from sugar production and its reuse. Methods of wastewater treatment of sugar factories. Dust collection at sugar industry enterprises.* *References: [1] pp. 263-276.* *IWS: Ways to improve the water management of sugar factories.* *References: [3-5, 8]*	*2*
8	***Fundamentals of food alcohol production technology. Ecologization of food alcohol production***. *Fundamentals of alcohol production technology. Alcohol production wastes and*	*2*

	their reuse. Treatment of wastewater from alcohol production. *References: [1] pp. 277-285.* *IWS: Modernization of alcohol production. Environmental protection and modernization of alcohol production wastewater treatment facilities.* *References: [3-5, 8]*	
	Writing a module test paper	*0,4*
9	***Environmental protection when using pesticides.*** *Properties, classification and characterization of the most commonly used pesticides. Formation and methods of DDT neutralization. Technologies for the destruction of dioxins. Technological scheme of wastewater treatment of production of organochlorine compounds.* *References: [1] pp. 247-254, 258-261.* *IWS: Formation of dioxins as a result of pesticide degradation and their impact on living systems.* *References: [1] pp. 254-258, [6]*	*2*
10	***Basic concepts and processes of reactor technology.*** *Basic structure of a nuclear reactor, basic concepts and processes of reactor technology. Fission products in NPP coolant. Schematic diagram of NPP operation.* *References: [1] pp. 10-23.* *IWS: Prospects for the development of nuclear energy in Ukraine.* *References: [7]*	*2*
11	***Water treatment and water purification during NPP operation. Liquid radioactive waste disposal.*** *Water treatment at NPPs. Radioactive liquid waste at NPPs. Principal technological schemes for processing liquid radioactive waste of low and intermediate activity levels.* *References: [1] pp. 23-31.* *IWS: Nuclear Fuel Production and Processing in Ukraine.* *References: [7]*	*2*
12	***Ways to manage gaseous and solid radioactive waste.*** *Radioactive gaseous waste from NPPs. Radioactive solid waste from NPPs.* *References: [1] pp. 31-35.* *NRC: Diversification of nuclear fuel and technologies.* *References: [7]*	*2*
13	***Environmental pollution associated with coal mining.*** *Methods of coal mining. Features of the mine method of coal mining. Environmental impact of the coal industry and measures to reduce it.* *References: [1] pp. 35-44.* *IWS: Characteristics and applications of coal.* *References: [3-5, 8]*	*2*
14	***Environmental issues arising from coal mining and processing****.* *Wastewater from coal industry enterprises. Use of wastewater. Technology for purification of mine, quarry and coal preparation waters from suspended solids. Impact of the coal industry on the air basin. Solid waste and the state of land*	*2*

	resources. *References: [1] pp. 40-52.* *IWS: Fundamentals of coal preparation technology.* *References: [3-5, 8]*	
15	***Environmental pollution at TPPs and its protection.*** *Environmental pollution at TPPs and its prevention. Utilization of coal preparation waste, ash and slag from TPPs.* *References: [1] pp. 52-65.* *IWS: Basic concepts and processes of TPP operation.* *References: [3-5, 8]*	*2*
	Writing a module test paper	*0,4*
16	***Technology of cast iron production. Environmental problems and their solutions.*** *Sintering and blast furnace process. Blast furnace gas processing. Processing of iron ore mining and processing waste.* *References: [1] pp. 65-69.* *IWS: Characterization and chemical composition of cast iron.* *References: [3-5, 8]*	*2*
17	***Coke production. Use of coke products.*** *Coke production. Coking products and their use. Structure and operation of coke ovens. Waste from coke production and its processing. Problems of organization of closed water circulation systems at coke plants.* *References: [1] pp. 70-75.* *IWS: Chemical processing of coal.* *References: [3-5, 8]*	*2*
18	***Steel production and its hardware design.*** *Steel classification and technology. Steel production in oxygen converters. Steel production in open-hearth furnaces. Electric furnaces.* *References: [1] pp. 75-82.* *IWS: Steel rolling.* *References: [1] pp. 82-83, [3-5, 8]*	*2*
19	***Generation and processing of wastewater from metallurgical enterprises. Utilization of ferrous metallurgy waste.*** *Wastewater from ferrous metallurgy enterprises and ways to treat it. Waste management in ferrous metallurgy.* *References: [1] pp. 83-102.* *IWS: Wastewater disposal systems with minimal discharge of wastewater into water bodies. Air pollution in ferrous metallurgy and its prevention.* *References: [3-5, 8]*	*2*
20	***Technology for the production of ferrosilicon and ferromanganese.*** *Fundamentals of ferroalloy production technology. Purification of waste gases from ferroalloy furnaces. Water recycling and wastewater treatment of wet gas cleaning.* *References: [1] pp. 102-119.* *IWS: Ferroalloy furnaces.* *References: [3-5, 8]*	*2*

	Writing a module test paper	*0,4*
21	***Oil production and refining methods***. *Composition and properties of oil. Products of oil refining. Preparation of oil for refining. Basic methods of refining.* *References: [1] pp. 115-127.* *IWS: A piece of equipment used in oil refining.* *References: [3-5, 8]*	*2*
22	***Environmental safety of oil and oil products refining.*** *Treatment of petroleum products. Wastewater from oil refineries. Local wastewater treatment from oil treatment plants.* *References: [1] pp. 127-133.* *IWS: Generation, processing and reuse of oil refinery wastes.* *References: [3-5, 8]*	*2*
23	***Generation and utilization of gaseous and solid waste from oil refineries***. *Solid waste processing. Gaseous waste and its disposal. Treatment of sulfide-containing process condensates.* *References: [1] pp. 133-136.* *IWS: Abatement of gas emissions during oil refining.* *References: [3-5, 8]*	*2*
24	***Construction industry. Impact on the environment. Technologies for the production of binders.*** *Technology for the production of gypsum binders. Technology of construction lime production. Technology of Portland cement production.* *References: [1] pp. 136-148.* *IWS: Properties and uses of lime.* *References: [3-5, 8]*	*2*
25	***Construction industry. Impact on the environment. Technology of manufacturing concrete and reinforced concrete products.*** *Production of silicate bricks and stone. Classification of concrete. Materials for the manufacture of concrete. Production of concrete and reinforced concrete products.* *References: [1] pp. 148-155.* *IWS: Ceramic products.* *References: [3-5, 8]*	*2*
26	***Production of glass and technical glass products. The impact of the construction industry on the environment.*** *Types and chemical composition of glass. Technological process of glass manufacturing. Utilization of waste from the production of building materials.* *References: [1] pp. 156-166.* *IWS: Features of glass production.* *References: [3-5, 8]*	*2*
	Writing a module test paper	*0,4*
	Total	***54***

6. Independent work of the student

Independent work takes up 60% of the course time, including exam preparation. The main task of students' independent work is to master scientific knowledge in areas not included in the list of lecture topics through personal search for information, and to develop an active interest in a creative approach to academic work. In the process of independent work within the educational component, students should learn to analyze in-depth modern approaches to the development and implementation of the latest technologies for the processing of liquid, gaseous and solid waste from industrial enterprises, taking into account the technological features of industrial production.

No. s/n	Name of the topic to be studied independently	Number of hours of IWS
	Section 1. Environmental safety of the mineral fertilizer industry.	
1	IWS: Production of chlorine-free potash fertilizers. References: [1] pp. 212-215, [3-5, 8] IWS: Waste from phosphorus production. References: [3-5, 8] IWS: Production of nitric acid. Removal of nitrous gases from nitrogen oxides. Production of liquid ammonia fertilizers. References: [3-5, 8]	5
	Preparing for the test on section 1	1
	Section 2. Environmental safety of the dye and fiber industry.	
2	IWS: Features of obtaining artificial fibers and synthetic fibers. References: [3-5, 8] IWS:. Environmental impact of dyes and related contaminants. References: [1] pp. 227-228, [3-5, 8]	5
	Section 3. Wastewater treatment and recycling of food industry waste.	
3	IWS: Ways to improve the water management of sugar factories. References: [3-5, 8] IWS: Modernization of alcohol production. Environmental protection and modernization of alcohol production wastewater treatment facilities. References: [3-5, 8]	5
	Preparing for the test in Chapters 2-3	2
	Chapter 4. Environmental problems of pulp, paper and cardboard production. Ways to solve them.	
4	Pulp production and its application. General technological scheme of paper and cardboard production. Characterization of the main fiber semi-finished products and their papermaking properties. Gluing, filling and coloring of paper and cardboard. Treatment of pulp and paper production wastewater and utilization of valuable products from wastewater. Technological methods that eliminate or reduce wastewater generation. Recycling of secondary pulp-containing raw materials. Cleaning and recovery of gas and dust emissions from pulp and paper production. Literature: Literature: [3-5, 8]	5
	Section 5. Environmental protection in the use of pesticides.	

5	*IWS: Formation of dioxins as a result of pesticide degradation and their impact on living systems.* *References: [1] pp. 254-258, [6]*	*3*
Chapter 6. Environmental problems of the energy sector and ways to solve them.		
6	*IWS: Prospects for the development of nuclear energy in Ukraine. Extraction and processing of nuclear fuel in Ukraine. Diversification of nuclear fuel and technologies.* *References: [7]* *IWS: Characteristics and applications of coal. Fundamentals of coal preparation technology. Basic concepts and processes of TPP operation.* *References: [3-5, 8]*	*5*
	Preparing for the test in Chapters 4-6	*3*
Section 7. Impact of metallurgical enterprises on the environment. Environmental protection.		
7	*IWS: Characterization and chemical composition of cast iron. Chemical processing of coal. Rolling of steel.* *References: [1] pp. 82-83, [3-5, 8]* *IWS: Wastewater disposal systems with minimal discharge of wastewater into water bodies. Air pollution in ferrous metallurgy and its prevention. Ferroalloy furnaces.* *References: [3-5, 8]*	*5*
	Preparing for the chapter 7 test	*1*
Section 8. Oil refining industry. Environmental problems of the industry.		
8	*IWS: Hardware used in oil refining. Generation, processing and reuse of oil refining wastes. Elimination of gas emissions during oil refining.* *References: [3-5, 8]*	*5*
Chapter 9. Construction industry. Impact on the environment.		
9	*IWS: Properties and application of lime. Ceramic products. Features of glass production.* *References: [3-5, 8]*	*3*
	Preparing for the test in Chapters 8-9	*3*
	Preparing for the exam	*30*
	Total hours	*81*

Policy and control

7. Policy of the academic discipline

Rules of attendance and behavior in the classroom

Students are obliged to actively participate 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, and not to be distracted by activities unrelated to the educational process.

Rules for awarding reward and penalty points

- *incentive points can be awarded by the teacher only for the performance of creative works in the discipline or additional online specialized courses with the receipt of a relevant certificate:*

https://www.coursera.org/learn/electric-power-systems

https://www.coursera.org/learn/oilandgas

However, their total cannot exceed 10% of the rating scale.

- *no penalty points are provided for in the discipline.*

Policy of deadlines and retakes

In the event of debts in the discipline or any force majeure circumstances, students should contact the teacher through 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 absence of references when using printed and electronic materials, quotes, and opinions of other authors. Hints and cheating during tests and classes are unacceptable; passing a test for another student; copying materials protected by copyright 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". For more details: https://kpi.ua/code

Policy of academic behavior and ethics

Students should be tolerant, respect the opinions of others, formulate objections in the correct form, and provide constructive 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". For more details: https://kpi.ua/code

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

Allocation of study time by type of class and assignments in the discipline according to the working curriculum:

Semester	*Study time*		*Distribution of training hours*				*Control measures*		
	Loans	*acad. H*	*Lectures*	*Practical*	*Lab.*	*IWS*	*MCT*	*PP*	*Semester control*
3	*4,5*	*135*	*54*	*-*	*-*	*81*	*1*	*-*	*examination*

A student's rating in a discipline is made up of the points he or she receives for it:

A student's rating in a discipline is made up of the points he or she receives for it:

1) five control papers (the MCT is divided into 5 papers lasting 0.4 academic hours each)

2) answer to the exam.

Rating (weight) points system and evaluation criteria:

1. Modular control tests.

The weighting score is 10. The maximum number of points for all tests is equal to: 10 points x 5 papers = 50 points

Criteria for grading tests

Ball	*Completeness of the answer*
10	*Full answer.*
8-9	*The answer does not include secondary or dependent on the main parameters (materials)*
7	*The answer does not include half of the main parameters and several minor parameters or materials*
6	*Superficial answer without analysis of parameters, conditions, materials, facts, incomplete conclusions*

1-5	*The test is not credited*

Thus, the semester rating scale in the discipline is:

$$R_C = 10\text{-}5 = 50 \text{ points}$$

The exam component is equal to 50% of R:

$$R_{екз} = 50 \text{ points}$$

Thus, the rating scale for the discipline is as follows:

$$R = R_C + R_{екз} = 50 + 50 = 100 \text{ points}$$

The maximum score of the starting component is 50 points. A prerequisite for admission to the exam is a starting rating of at least 30 points.

Based on the results of the first 7 weeks, an "ideal student" should score 20 points (for 2 tests in weeks 4 and 7). At the first assessment (week 8), a student receives a "pass" if their current rating is at least 12 points.

Based on the results of academic work over 13 weeks of study, an "ideal student" should score 40 points (for 4 tests in weeks 4, 7, 10, and 13). At the second assessment (week 14), a student receives a "pass" if their current rating is at least 24 points.

During the exam, students complete a written test. Each task contains 2 questions. Each question is worth 25 points. Question grading system:

Completeness and signs of response	***Points.***
Full answer.	*22-25*
A fairly complete answer with some inaccuracies	*18-21*
The answer does not include secondary or dependent on the main parameters (materials)	*15-17*
The answer does not include half of the main parameters and several minor parameters or materials	*11-14*
Superficial answer without analysis of parameters, conditions, materials, facts, incomplete conclusions	*5-10*
The test is not credited	*0-4*

Rating scale in the discipline

Number of points	***Assessment.***
95...100	*excellent*
85...94	*very well*
75...84	*well*
65...74	*satisfactorily*
60...64	*sufficiently*
RD < 60	*unsatisfactorily*
The conditions for admission are not met	*not allowed*

9. Additional information on the discipline

An approximate list of questions to be submitted for semester control

List of questions for the exam

1. *Give a description of the composition of sugar beet root.*
2. *Present a technological scheme of a beet sugar plant.*
3. *Describe the chemical processes involved in sugar beet processing.*
4. *Give a description of the technological process of acetate fiber production.*

5. *Give a description of the technological process of obtaining polyamide fiber.*
6. *Describe the methods of wastewater treatment for the production of acetate and polyamide fibers.*
7. *Give a description of the composition of sugar-containing raw materials in the production of alcohol.*
8. *Describe the technology of alcohol production.*
9. *To characterize the composition of by-products (etherealdehyde fraction, fusel oils) in the production of food alcohol.*
10. *Give a description of the technological process of obtaining viscose fibers.*
11. *Describe the methods of wastewater treatment from carbon dioxide and hydrogen sulfide.*
12. *Describe hydrogen as an environmentally friendly energy source.*
13. *Give a description of the technological process of natural gas methane conversion.*
14. *Describe methods for purifying methane from sulfur-containing compounds.*
15. *Describe the composition of the converted gas from hydrogen production.*
16. *Provide a description of the methods for cleaning the converted gas and CO_2 .*
17. *Give a description of the methods of purification of converted gas and CO.*
18. *Describe the methods of nitrogen production in ammonia production.*
19. *Describe the technological process of ammonia synthesis.*
20. *Give a description of the methods for cleaning gas emissions from ammonia.*
21. *Describe the characteristics of nitrogen fertilizers.*
22. *Describe the technological scheme for the production of ammonium nitrate by the packing method.*
23. *Describe the technological scheme for the production of ammonium nitrate by the non-steam method.*
24. *Describe the characteristics of nitrogen fertilizers.*
25. *Describe the technological scheme of urea production.*
26. *Describe the processes of ammonium sulfate and ammonium nitrate production.*
27. *Describe sugar production waste and its processing. Present a schematic diagram of a nuclear reactor.*
28. *Describe the components of a nuclear reactor.*
29. *Describe the processes of reactor technology.*
30. *To give a comparative characterization of liquid radioactive waste of low and intermediate activity levels.*
31. *Present the technological scheme of radioactive water treatment.*
32. *Describe the technological scheme of radioactive water treatment using coagulation and ion exchange.*
33. *Present technological methods for reducing the volume of liquid radioactive waste.*
34. *Give a comparative characterization of cementing and bituminizing methods.*
35. *Identify the advantages of vitrification as the best method of waste solidification.*
36. *Describe the methods of liquid radioactive waste disposal.*
37. *To present technological methods for reducing the activity of gaseous waste.*
38. *Describe the methods of decontamination of solid radioactive waste.*
39. *Give the characteristics of raw materials for blast furnace production.*
40. *Describe the structure of a blast furnace.*
41. *Describe the chemical processes that occur in a blast furnace.*

42. *Describe the process of coal coking.*
43. *Describe the device of coke ovens.*
44. *Give a description of coking products and ways to use them.*
45. *Describe the methods of ore dressing wastewater treatment.*
46. *Give a description of the technological scheme of wastewater treatment of blast furnace production.*
47. *To characterize the methods of wastewater treatment of pickling production.*
48. *Give a description of the technological scheme of direct coke oven gas processing.*
49. *To characterize the methods of wastewater treatment of coke production.*
50. *Describe the methods of processing solid waste from coke production.*
51. *Give a description of raw materials for steel production.*
52. *Describe the device of the oxygen converter.*
53. *Show the chemical processes that take place in an oxygen converter.*
54. *Describe the device of an arc furnace.*
55. *Give a description of an induction furnace.*
56. *Give a description of the methods of wastewater treatment generated during steel production in oxygen converters.*
57. *Describe the methods of treatment of wastewater generated during hot rolling.*
58. *Describe the technology of manufacturing building lime.*
59. *To determine the possibilities of using metallurgical waste in the production of Portland cement.*
60. *Characterize the possibilities of using waste from the production of building materials.*

Questions for module tests

MCP 1

Option 1:

1. Give a diagram of the production of ammonium nitrate.

2. Describe the methods of cleaning the converted gas from CO_2 .

Option 2:

1. Describe the scheme of phosphogypsum processing.

2. Describe the methods of producing potash fertilizers.

Option 3:

1. Give a technological scheme of phosphoric acid production.

2. Describe the methods of purification of converted gas from CO.

MCP 2

Option 1:

1. Give general information and classification of chemical fibers.

2. Present the technology of alcohol production in the food industry.

Option 2:

1. Describe the technology of wastewater treatment of alcohol production.

2. Give the reactions for the production of synthetic fibers.

Option 3:

1. Describe the complex processing of molasses in alcohol production.

2. Describe the methods of wastewater treatment from dyes.

MCP 3

Option 1:

1. Describe the methods of decontamination of solid radioactive waste.

2. Give ways to prevent dust emissions from thermal power plants.

Option 2:

1. To give a comparative characterization of liquid radioactive waste of low and intermediate activity levels.

2. Describe the methods of pesticide disposal.

Option 3:

1. Give a scheme for the treatment of dioxin-containing wastewater.

2. Give ways to prevent emissions of acid gases from thermal power plants.

MCP 4

Option 1:

1. Give methods of treatment of wastewater generated during the neutralization of blast furnace gas.

2. Give the reactions for the production of ferromanganese.

Option 2:

1. Give a description of the technological process of coking.

2. Describe the methods of treatment of hot rolling wastewater.

Option 3:

1. Give schemes for cleaning waste gases from the production of ferrosilicon and ferromanganese.

2. Describe the method of processing direct coke oven gas.

MCP 5

Option 1:

1. Justify the technology of oil preparation for refining.

2. Describe the methods of utilization of waste from the production of building materials.

Option 2:

1. Describe the products obtained during oil refining.

2. Describe the method of purification of sulfide-containing process condensates.

Option 3:

1. To determine the possibilities of using metallurgical waste in the manufacture of Portland cement.

2. Describe ways to clean oil products.

Work program of the discipline (syllabus):

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Approved by *the Department of E and TPP (protocol № 14 from 8.06.2022).*

Approved by *the ICF Methodological Commission (protocol № 10 from 24.06.2022)*