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

Department of Ecology and Technology of Plant Polymers

Basics of industrial emissions treatment processes for dust

Work program of the academic discipline (Silabus)

Details of the discipline

Level of higher education	***First (educational and professional)***
Field of expertise	*16 Chemical and bioengineering*
Speciality	*161 Chemical technology and engineering*
Educational program	*Industrial ecology and resource-efficient clean technologies*
Status of the discipline	*Selective*
Form of study	*full-time/distance/mixed*
Year of study, semester	*2nd year / fall semester*
Scope of the discipline	*4 ECTS credits (120 hours)*
Semester control / control measures	*Test*
Class schedule	*4 hours per week (2 hours of lectures and 1 hour of laboratory classes, 1 hour of practical classes)*
Language of instruction	*Ukrainian*
Information about course leader / teachers	Lecturer: https://eco-paper.kpi.ua/pro-kafedru/vykladachi/ivanenko-olena-ivanivna.html Practical: https://eco-paper.kpi.ua/pro-kafedru/vykladachi/ivanenko-olena-ivanivna.html Laboratory: https://eco-paper.kpi.ua/pro-kafedru/vykladachi/ivanenko-olena-ivanivna.html
Placement of the course	*https://do.ipo.kpi.ua/course/view.php?id=5236*

Program of the discipline

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

In order to prevent the negative effects of human activity and improve the condition of the air in terms of particulate matter, it is necessary to constantly improve air protection technologies. It is only with the help of knowledge of cleaning gas emissions from dust, as well as setting up work with atmospheric air quality assessment devices, that it is possible to protect the environment from the negative anthropogenic impact on the planet's airspace.

The subject of the discipline "Basics of industrial emissions treatment processes for dust" *is one of the main areas of implementation of environmental technologies aimed at protecting the atmosphere, and it is the removal of gaseous waste from dust before it is released into the atmosphere.*

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 solve the problems of protecting and preserving the atmosphere, specialists must be fluent in information and be able to solve complex problems of air protection from pollution at a high professional level.

Objective of the discipline "Basics of industrial emissions treatment processes for dust"

The purpose of this discipline is to develop students' knowledge in the field of modern methods of gas purification, a set of skills and abilities necessary for conducting research in this area, for creating modern gas purification technologies and for qualified management of existing technological processes. In accordance with the goal, the training of bachelors requires strengthening the competencies formed by students:

- *Ability to use modern materials, technologies and apparatus designs in chemical engineering*
- *Ability to select and use appropriate equipment, tools and methods to control and manage chemical production processes*
- *Ability to prepare technical documentation in accordance with applicable requirements*
- *Ability to use computer-aided design systems to develop design documentation*
- *Ability to apply modern experimental methods of working with technological objects in industrial and laboratory conditions*
- *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*
- *Ability to design and implement technologies for the treatment and processing of source gases, wastewater and solid waste.*

*In accordance with the requirements of the program of the discipline "**Basics of industrial emissions treatment processes for dust"**, students must demonstrate the following program learning outcomes after completing it:*

- *Develop and implement projects related to chemical production technologies and equipment, taking into account goals, resources, constraints, social and economic aspects and risks*
- *Ensure the safety of personnel and the environment during professional activities in the field of chemical engineering*
- *Develop project documentation, taking into account the requirements of standards*
- *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 "**Basics of industrial emissions treatment processes for dust"** is based on the principles of integrating the various knowledge gained by students during their bachelor's degree in natural and engineering disciplines: "General and Inorganic Chemistry", "Engineering Graphics", "Computer Graphics".*

*The discipline "**Basics of industrial emissions cleaning processes from dust"** is the fundamental basis for the study of the following disciplines: "General Chemical Technology", "Control and Management of Chemical and Technological Processes", "Environmental Safety of Production", and ensures the implementation of a bachelor's project.*

3. Content of the discipline *"Basics of industrial emissions treatment processes for dust"*

Chapter 1. Current state, directions and prospects for the development of air pollution protection.

Topic 1: *Composition, structure, properties and functions of the atmosphere.*

Topic 2. *Characterization of air pollutants and classification of pollution sources.*

Topic 3. *Standardization of atmospheric air quality.*

Topic 4. *Main sources of air pollutant emissions by industry sectors*

Topic 5. *Transformation of impurities in the atmosphere.*

Topic 6. *Dispersion of pollutants in the atmosphere.*

Section 2: Cleaning the exhaust gases from dust.

Topic 1: *Basic properties of dust.*

Topic 2. *Dust collection. Parameters of the dust collection process.*

Section 3. Dry mechanical gas purification devices.

Topic 1: *Dust settling chambers and inertial dust collectors.*

Topic 2. *Blinds and cyclones.*

Topic 3: *Vortex dust collectors.*

Section 4. Wet mechanical gas purification devices.

Topic 1: Nozzle *scrubber, nozzle scrubber, scrubber with a moving nozzle.*

Topic 2. *Centrifugal scrubber, venturi scrubber, impactor, bubbling-foam apparatus.*

Section 5. Apparatus for gas purification by filtration.

Topic 1: *Fiber and granular filters.*

Topic 2. *Fabric filters.*

Chapter 6. Apparatus for purification of gases in an electric field.

Topic 1: *Classification of electrostatic precipitators and their structural elements.*

Topic 2. *Dry and wet electrostatic precipitators.*

Training materials and resources

Basic literature

1. Beketov V.E., Yevtukhova G.P. Sources and processes of atmospheric pollution. Kharkiv: A. N. Beketov Kharkiv National University of Oil and Gas Industry, 2019. 113 c. https://core.ac.uk/download/pdf/228030186.pdf

2. Sarapina M.V. Processes and devices of dust and gas purification: a course of lectures. Kharkiv: NUCSU, 2018. 125 c.

3. Krusir G.V., Madani M.M., Garkovich O.L. Techniques and technologies of gas emissions treatment. Odesa: ONAHT-Odesa, 2017. 207 c.

4. Lecture notes on the discipline "Technologies of treatment and utilization of industrial wastewater and
Emissions" (Part I) for students of the training program 6.051301 - "Chemical Technology", 6.040106 "Ecology, Environmental Protection and Sustainable Nature Management" and 6.051401 "Industrial Biotechnology", Compiler: Oliynyk M.A.
- Kamianske: DSTU, 2016. - 56 pp.

5. Methods of calculation of complex dust and gas cleaning systems. Monograph / M.I. Shilyaev, E.M. Khromova. M: DIA Publishing House, 2018. 196 c.

6. Ivanenko O.I. Methodical instructions for the implementation of course projects in the course "Technology and equipment for atmospheric protection" for students of the training direction 6.040106 "Ecology, environmental protection and balanced nature management". -K.: Infodruk LLC, -2012. -107 c.

7. Fundamentals of industrial emissions cleaning processes from dust. Laboratory workshop: a textbook for students majoring in 101 Ecology, 161 Chemical Technology and Engineering / Igor Sikorsky Kyiv Polytechnic Institute; compiled by Ivanenko O.I., Overchenko T.A., Nosachova Y.V., Tverdokhlib M.M. - Kyiv: Igor Sikorsky Kyiv Polytechnic Institute, 2021. 34 p.

Additional literature

8. Industrial technologies and purification of technological and ventilation emissions: a textbook / Yurkevych Y., Voznyak O., Zhelykh V.; Ministry of Education and Science of Ukraine, Lviv Polytechnic National University.
2012. 120 c.
9. Severin L. I., Petruk V. G., Bezvoziuk I. I., Vasylkivsky I. V. Environmental technologies (protection of the atmosphere) / Part I: Study guide. Vinnytsia: Universum-Vinnytsia, 2010. https://web.posibnyky.vntu.edu.ua/iebmd/severin_priodoohoronni_tehnologii/dop-m.html
10. Ratushniak G.S., Lyalyuk O.G. Means of cleaning gas emissions. Study guide. Vinnytsia: Universum-Vinnytsia, 2008. 207 c.
11. Ecology and environmental protection: a textbook. Kyiv: Znannya, 2007. 422 c.
12. Kuznetsov I.E., Shmat K.I., Kuznetsov S.I. Equipment for sanitary gas cleaning. Handbook. Kyiv: Technika, 1989. 204 c.
13. Environmental protection. Edited by Duganov G. V. Kyiv: Vysha Shkola, 1991. 320 c.
14. Kundro N.V., Davydenko N.V. Cleaning of ventilation outlets. http://elib.psu.by:8080/handle/123456789/3181
15. Beketov V. E. Lecture notes for the course "Applied Aeroecology". Module 1 "Atmosphere. Basic terms and definitions" (for 2nd year students of full-time education in the direction of 6.040106 "Ecology, environmental protection and balanced nature management") / Kharkiv National Academy of Municipal Economy; V. Beketov, G. Yevtukhova, Y. Kovalenko. KHARKIV: KHNAMU, 2011. 44 c.
16. Beketov V. E. Lecture notes on the section "Methods and devices for monitoring concentrations of dust and gas impurities in the atmosphere and in industrial emissions" in the discipline "Methods and
Atmospheric air monitoring devices" (for full-time 5th year and 6th year students)
part-time students of specialty 7.070801 (7.04010601) - "Ecology and protection
Beketov V.E., Yevtukhova G.P., Kovalenko Y.L.; Kharkiv National University.
acad. of municipal economy. KHARKIV: KHNAMU, 2011. 40 c.
17. Ecology of the city. Edited by F.V. Stolberg. -K. : Libra, -2000. - 464 c.
18. KD 52.9.4.01-09. Guidelines for forecasting meteorological conditions for the formation of air pollution levels in Ukrainian cities. Kyiv: State Hydrometeorological Service, 2010. 78 c.
19. Ryzhkov S.S. Apparatus for air purification from pollution: methodical instructions / S.S. Ryzhkov, Y.M. Kharitonov, V.V. Blagodatny. - Mykolaiv : UDMTU, 2002. - 36 c.
Information resources on the Internet
20. Ministry of Environmental Protection and Natural Resources of Ukraine / [Electronic resource]. - Access mode: https://mepr.gov.ua/.
21. Industrial ecology. Community of environmentalists / [Electronic resource]. - Access mode: http://www.eco.com.ua/.
22. Professional Association of Ecologists of Ukraine / [Electronic resource] - Access mode: https://paeu.com.ua/.
23. Denysenko Scientific and Technical Library / [Electronic resource] - Access mode: https://library.kpi.ua.
24. Vernadsky National Library / [Electronic resource] - Access mode: http://www.nbuv.gov.ua/.
25. Electronic archive of scientific and educational materials of Igor Sikorsky Kyiv Polytechnic Institute / [Electronic resource] - Access mode: https://ela.kpi.ua/.

Educational content

5. Methods of mastering the discipline

Lecture classes

Lecture classes are aimed at:

- *providing modern, holistic, interdependent knowledge in the discipline "**Basics of industrial emissions treatment processes for dust**", 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;*
- *determination of the current level of scientific development in the field of modern methods and processes of gas purification, forecasting development for the coming years;*
- *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 for this 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)	Hours
1	**Current state, directions and prospects for the development of air pollution protection** *Composition, structure, properties and functions of the atmosphere. Anthropogenic impact on the state of the atmosphere.* *References: [1, 11, 13, 15]* *IWS. Directions and goals of creating low-waste industries. Literature: [4].*	2
2	**Current state, directions and prospects for the development of air pollution protection** *Characterization of air pollutants from industrial enterprises and classification of pollution sources.* *References: [1, 11, 13, 15]* *IWS. Air pollution by mobile sources of road transport.* *Literature: [1].*	2
3	**Current state, directions and prospects for the development of air basin protection against pollution** *Air quality regulation.* *Literature: [1, 9].* *IWS. Ukrainian cities with the highest emissions of harmful substances into the atmosphere and the distribution of pollution by source. Literature: [15].*	2
4	**Current state, directions and prospects for the development of air pollution protection** *Main sources of air pollutant emissions by industry sectors* *Literature: [1].* *IWS. Transboundary transfer of pollutants. Literature: [1].*	2
5	**Current state, directions and prospects for the development of air pollution protection**	2

	Transformation of impurities in the atmosphere. *References: [1, 11, 13, 15]* *IWS. Physical pollutants of the atmosphere.* *Literature: [1].*	
6	***Current state, directions and prospects for the development of air pollution protection*** *Dispersion of pollutants in the atmosphere.* *Literature: [1, 17, 18].* *IWS. The content and fluctuations of concentrations of harmful impurities in the air of cities depending on factors such as precipitation and fog. Literature: [18].*	*2*
7	***Cleaning the exhaust gases from dust*** *The main properties of dust.* *Literature: [1, 9].* *IWS. Basic properties of gases.* *Literature: [9].*	*2*
8	***Cleaning the exhaust gases from dust*** *Dust collection. Dust collection process parameters.* *Literature: [9, 10].* *IWS. Methods and instruments for monitoring the concentration of dust impurities in the atmosphere and industrial emissions.* *Literature: [16].*	*2*
9	***Dry mechanical gas cleaning devices*** *Dust collecting chambers and inertial dust collectors.* *Literature: [2, 3, 4, 12, 14].* *IWS. Irrigation flues.* *Literature: [2, 3, 4, 12, 14].*	*2*
10	***Dry mechanical gas cleaning devices*** *Blinds, cyclones.* *Literature: [2, 3, 4, 12, 14].* *IWS. Rotary dust collectors.* *Literature: [19].*	*2*
11	***Dry mechanical gas cleaning devices*** *Vortex dust collectors.* *Literature: [2, 3, 4, 12, 14].* *IWS. Dynamic dust collectors.* *Literature: [9].*	*2*
12	***Wet mechanical gas cleaning devices*** *Nozzle scrubber, nozzle scrubber, scrubber with moving nozzle.* *Literature: [2, 3, 4, 12, 14].* *IWS. Mechanical disk scrubber.* *Literature: [19].*	*2*
13	***Wet mechanical gas cleaning devices*** *Centrifugal scrubber, venturi scrubber, impact and inertial type device, bubbling and foaming device.* *Literature: [2, 3, 4, 12, 14].* *IWS. Doyle's high-speed scrubber.* *Literature: [19].*	*2*
14	***Apparatus for gas purification by filtration.*** *Fiber and granular filters.* *Literature: [2, 3, 4, 12, 14].*	*2*

	IWS. Ceramic and metal-ceramic filters. *Literature: [9].*	
15	***Apparatus for gas purification by filtration*** *Fabric filters.* *Literature: [2, 3, 4, 12, 14].* *IWS.* *Literature: [19]. Filter mist eliminators.*	*2*
16	***Apparatus for gas purification in an electric field*** *Classification of electrostatic precipitators and their structural elements.* *Literature: [2, 3, 4, 12, 14].* *IWS. Magnetic purification of gases.* *Literature: [9].*	*2*
17	***Apparatus for gas purification in an electric field*** *Dry and wet electrostatic precipitators.* *Literature: [2, 3, 4, 12, 14].* *IWS. Recovery of captured dust.* *Literature: [4].*	*2*
18	***MCT***	*2*
	Total	***36***

Laboratory classes

In the system of professional training of students, laboratory classes take up 25% of the classroom *load. As a supplement to the lecture course, they lay the foundation and form the basis of the Bachelor's degree in ecology. The purpose of laboratory classes is to develop students' experimental skills, research approach to the* subject, and consolidate theoretical material.

No. s/n	*Name of the laboratory work*	*Number of classroom hours*
1	*Introduction. Safety briefing, familiarization with the program of laboratory work, issuance of methodological literature*	*1*
2	*Determining the amount of dust in the air*	*3*
3	*Determination of dust radioactivity in the air*	*3*
4	*Determination of physical properties of industrial dust*	*3*
5	*Determination of dust cleaning efficiency in cyclones*	*3*
6	*Determining the efficiency of dust cleaning in bag filters*	*3*
7	*Test*	*2*
Total hours		*18*

Practical classes

In the system of professional training of bachelors in this discipline, practical classes take up 25% of the class load. Being a supplement to the lecture course, they lay down and form the basis of a bachelor's qualification in the field of ecology, namely the protection of the atmosphere from anthropogenic impact. 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 your 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 bachelors as creative workers in the field of environmental protection.

The main tasks of the cycle of practical classes:

- *to help bachelors systematize, consolidate and deepen their theoretical knowledge in the field of fundamental methods and technologies of air purification;*
- *to teach bachelors methods of solving practical problems, to promote the acquisition of skills and abilities to perform calculations, graphic and other tasks;*
- *teach them how to work with scientific and reference literature and diagrams;*
- *to develop the ability to learn independently, i.e. to master the methods, ways and techniques of self-study, self-development and self-control.*

No. s/n	***Name of the topic of the practical lesson and a list of key issues (list of didactic support, references to literature and assignments for IWS)***	***Hours***
1	***Calculation of the material balance***. *Literature: [6].*	***2***
2	***Calculation of a dry gravity-type dust collector using a simplified method***. *Literature: [6].*	***2***
3	***Calculation of a dry gravity-type dust collector using a complicated methodology***. *Literature: [6].*	***3***
4	***Calculation of a dry centrifugal dust collector***. *Literature: [6].*	***3***
5	***Calculation of a nozzleless scrubber.*** *Literature: [6].*	***2***
6	***Calculation of a fabric bag filter.*** *Literature: [6].*	***3***
7	***Calculation of an electrostatic precipitator.*** *Literature: [6].*	***3***
	Total	***18***

6. Independent work of a student/graduate student

Independent work takes up 40% of the credit module study time, including preparation for the test. The main task of students' independent work is to master scientific knowledge in areas that are not included in the list of lecture topics through personal search for information, the formation of 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 treatment of polluted waste gases, based on the concentrations of pollutants and emission standards for the gas mixture. The student must be able to create the most effective methods for cleaning contaminated gases.

No. s/n	*Name of the topic to be studied independently*	*Number of hours of IWS*
Chapter 1. Current state, directions and prospects of development of air basin protection from pollution		
1	*Topic 1: Composition, structure, properties and functions of the atmosphere. Anthropogenic impact on the state of the atmosphere. Composition, structure, properties and functions of the atmosphere. Anthropogenic impact on the state of the atmosphere. IWS. Directions and goals of creating low-waste industries. Literature: [4].*	*15*

	Topic 2. Characterization of air pollutants from industrial enterprises and classification of pollution sources. *IWS. Air pollution from mobile sources of road transport.* *Literature: [1].* *Topic 3. Standardization of atmospheric air quality.* *IWS. Ukrainian cities with the highest emissions of harmful substances into the atmosphere and the distribution of pollution by source.* *Literature: [15].* *Topic 4. Main sources of air pollutant emissions by industry sectors* *IWS. Transboundary transfer of pollutants.* *Literature: [1].* *Topic 5. Transformation of impurities in the atmosphere.* *IWS. Physical pollutants of the atmosphere.* *Literature: [1].* *Topic 6. Dispersion of pollutants in the atmosphere.* *IWS. The content and fluctuations in the concentration of harmful impurities in the air of cities depending on factors such as precipitation and fog.* *Literature: [18].*	
	Section 2: Cleaning the exhaust gases from dust	
2	*Topic 1: Basic properties of dust.* *IWS. Basic properties of gases.* *Literature: [9].* *Topic 2. Dust collection. Parameters of the dust collection process.* *IWS. Methods and instruments for monitoring the concentration of dust impurities in the atmosphere and industrial emissions.* *Literature: [16].*	*5*
	Section 3. Dry mechanical gas purification devices	
3	*Topic 1: Dust settling chambers and inertial dust collectors.* *IWS. Irrigation flues.* *Literature: [2, 3, 4, 12, 14].* *Topic 2. Blinds and cyclones.* *IWS. Rotary dust collectors.* *Literature: [19].* *Topic 3: Vortex dust collectors.* *IWS. Dynamic dust collectors.* *Literature: [9].*	*8*
	Section 4. Wet mechanical gas cleaning devices	
4	*Topic 1: Nozzle scrubber, nozzle scrubber, scrubber with a moving nozzle.* *IWS. Mechanical disk scrubber.* *Literature: [19].* *Topic 2. Centrifugal scrubber, venturi scrubber, impactor, bubbling-foam apparatus.* *IWS. Doyle's high-speed scrubber.* *Literature: [19].*	*5*
5	***Section 5. Apparatus for gas purification by filtration***	
	Topic 1: Fiber and granular filters. *IWS. Ceramic and metal-ceramic filters.* *Literature: [9].* *Topic 2. Fabric filters.* *IWS. Filter mist eliminators.* *Literature: [19].*	*5*

6	***Chapter 6. Apparatus for gas purification in an electric field***	
	Topic 1: Classification of electrostatic precipitators and their structural elements. *IWS. Magnetic purification of gases.* *Literature: [9].* *Topic 2. Dry and wet electrostatic precipitators.* *IWS. Recovery of captured dust.* *Literature: [4].*	*6*
	Preparing for the MCT	*2*
	Preparing for the test	*2*
	Total hours	*48*

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

- *The teacher may award incentive points only for the performance of creative works in the discipline or additional online specialized courses with the receipt of a certificate:*

https://www.coursera.org/specializations/climate-change-and-health

https://www.coursera.org/learn/global-warming

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

- *There are no penalty points within 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	120	36	18	18	48	1	-	Test

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 credit module is based on the points he or she receives for laboratory work and for writing a module test.

The semester control is a test.

System of rating (weight) points and evaluation criteria

Rating system and evaluation criteria:

Performing laboratory work.

The weighted score for laboratory work is 10 points. The maximum number of points for all laboratory works is equal:

10 points x 5 works = 50 points

Criteria for evaluating the performance of the laboratory task

Completeness and signs of task completion	***Points.***
The task has been completed in full	*10*
Minor deficiencies under item 1	*8-9*
Failure to complete a task on time	*7*
Late completion of the task, deficiencies under clause 1	*3-6*
Poor performance of the task	*1-2*
Failure to complete the task	*0*

Modular control test

The weighting score is 50 points. The maximum number of points for the test is equal to:

50 points x 1 work = 50 points

Criteria for grading tests

Completeness and signs of response	***Points.***
Full answer.	*45-50*
The answer does not include secondary or dependent on the main parameters (materials)	*35-44*
The answer does not include half of the main parameters and several minor parameters or materials	*25-34*
Superficial answer without analysis of parameters, conditions, materials, facts, incomplete conclusions	*11-24*
The test is not credited	*0-10*

Thus, the semester rating scale for the credit module is as follows:

R = 5 x 10 + 50 = 100 points

Based on the results of the first 7 weeks, an "ideal student" should score 40 points. At the first assessment (week 8), a student receives a "passed" grade if their current rating is at least 20 points.

Based on the results of the academic work over 13 weeks of study, an "ideal student" should score 90 points. At the second assessment (week 14), a student receives a "passed" grade if their current rating is at least 45 points.

The maximum score is 100 points. To receive a passing grade in the course, you must have a rating of at least 60 points. A prerequisite for admission to the test is the completion of all laboratory work and writing a module test.

Students who have a rating of less than 60 points at the end of the semester, as well as those who want to improve their ECTS score, take a test without a starting grade. The task of the test consists of 100 test questions from different sections of the discipline's work program. Each question of the test is evaluated at 1 point.

If the grade for the test is lower than the rating, the applicant receives the higher of the grade obtained from the results of the test or the rating.

The sum of the points for the control measures during the semester and for the final control work is converted to a final grade according to the table.

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

1. Describe the structure of the atmosphere.
2. List the main functions of the atmosphere.
3. Describe the main sources of dust pollution in the atmosphere.
4. Identify the main airborne dust pollutants.
5. Describe dust emissions from stationary and mobile sources.
6. Explain changes in the state of the environment based on observations in Ukraine.
7. Give the sectoral structure of emissions of harmful dust impurities into the atmosphere of Ukraine.
8. Name the cities of Ukraine with the highest emissions of harmful dust impurities into the atmosphere and the distribution of pollution by source.
9. Give the classification of methods of neutralization of gas emissions from dust.
10. List the main properties of dust.
11. How is the efficiency of dust collection determined?
12. Describe the main dust pollutants.
13. How are dust pollutants transformed in the atmosphere?
14. List the principles of environmental protection measures in the design of enterprises.
15. MPC of pollutants in the air of the working area.
16. How is the Gross Domestic Product calculated?
17. What forces cause the deposition of suspended particles in dry dust collectors?
18. Principle of operation, advantages and disadvantages of dust collecting chambers.

19. Give examples of designs of dust collecting chambers.
20. Principle of operation, advantages and disadvantages of inertial dust collectors.
21. Give examples of designs of inertial dust collectors.
22. What are the design features of louvered dust collectors?
23. Principle of operation, advantages and disadvantages of cyclones.
24. Give the classification of cyclones by design features.
25. Describe cyclones common in Ukraine and abroad.
26. Explain the use and design features of common types of general-purpose cyclones.
27. Principle of operation and design features of direct-flow cyclones.
28. When are group cyclones used and what are their technical characteristics?
29. Features of the use of battery cyclones and their technical characteristics.
30. Principle of operation and design features of vortex dust collectors.
31. What forces are used to clean gases in dynamic dust collectors and what are their design features?
32. Explain the method of determining the size of a dust collecting chamber.
33. Give the method of technological calculations of cyclones and determination of their structural dimensions.
34. Describe the purification of gases in wet electrostatic precipitators.
35. Describe the technology of gas purification in wet mechanical dust collectors.
36. Describe a centrifugal scrubber.
37. Describe a venturi scrubber.
38. Name the main types of filters.
39. Explain the principle of operation of the bag filter.
40. Name the main types of electrostatic precipitators.
41. Explain the principle of operation of electrostatic precipitators.
42. Name the areas of recovery of captured dust.

Work program of the discipline (syllabus):

Compiled by *Doctor of Technical Sciences, Associate Professor Ivanenko O. I.*

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)*