



## Syllabus Course Program



# Biosphere Protection Equipment

**Specialty**

101 Ecology

**Institute**

Educational and Research Institute of Mechanical Engineering and Transport

**Educational program**

Industrial Ecology

**Department**

Chemical engineering and industrial ecology (154)

**Level of education**

Master's level

**Course type**

Selective

**Semester**

2

**Language of instruction**

English, Ukrainian

## Lecturers and course developers

**Nataliia Samoilenko**

[Nataliia.Samoilenko@khpi.edu.ua](mailto:Nataliia.Samoilenko@khpi.edu.ua)

Candidate of Technical Sciences, Professor of the Department of Chemical Engineering and Industrial Ecology at NTU "KhPI". Author and co-author of more than 200 scientific and methodological publications. Conducted courses: "Organization and Management in Environmental Protection", "Technogenic and Ecological Safety Management", "Technology Systems and Engineering Ecology", "Biosphere protection equipment", "Technology for Decontamination and Utilization of Gas Emission Components", etc.

[More about the lecturer on the department's website](#)

## General information

### Summary

The discipline is aimed at developing students' theoretical and applied knowledge on modern equipment used to protect the biosphere, proficiency in creating innovations in the area of technical means of environmental protection, principles of apparatus design and calculation, polluted gas emissions and wastewater treatment plants used to develop and update environmental technologies.

### Course objectives and goals

Formation of students' systematic knowledge of modern treatment equipment, its design features and principle of operation, ability to substantiate ways to improve equipment and facilities characteristics, develop and design the most effective technical means of protecting elements of the biosphere to improve the environmental safety of industrial and non-industrial facilities.

### Format of classes

Lectures, practical studies, independent work, consultations. Course project. Final assessment in the form of an exam.

## Competencies

Knowledge of the latest engineering achievements and innovations in the field of technical means targeted on biosphere protection, ability to design and calculate equipment and apparatus for gas emissions and wastewater treatment, determination of the most effective technical means for use in the development of new nature conservation technologies.

## Learning outcomes

Ability to determine the most effective technical means of protecting the biosphere, knowledge and justification of ways to improve environmental protection devices, ability to develop, design, modernize equipment for technological lines and treatment facilities, ability to conduct basic engineering calculations of environmental protection devices within the system of developing new nature conservation technologies.

## Student workload

Total amount - 180 hours (6 ECTS credits): lectures - 48 hours, practical studies - 32 hours, self-study - 100 hours.

## Course prerequisites

To successfully complete the course student must have knowledge and practical skills obtained in the previous disciplines " Eco-innovation in Creating New Technologies ", " Equipment and basics of designing environmentally safe technologies using CAD"

## Features of the course, teaching and learning methods, and technologies

Lectures are conducted in an interactive form with the use of multimedia technologies. The traditional approach to teaching and the form of lecture-visualization are used. The topics of the course projects are characterized by relevance and novelty and are aimed at developing students' independent scientific research and creative approach to solving engineering and environmental problems.

## Program of the course

### Topics of the lectures

#### Topic 1. Sources of air pollution and characteristics of emissions.

Sectoral structure of emissions of harmful substances and main sources of their formation. Characteristics of emissions. Basic requirements for the selection of treatment equipment.

#### Topic 2. Equipment for dry treatment of emissions from dust

Classification of methods and equipment for dry emission treatment. Dust settling chambers and inertial dust collectors. Types of cyclones and their application. Emission treatment using filters. Designs of bag filters and electrostatic precipitators.

#### Topic 3. Treatment equipment for wet method of dust collection

Characteristics of the method and classification of apparatus. Hollow scrubbers. Centrifugal gas washers. Impact-inertial dust collection. Nozzle gas scrubbers. Design and technological features of Venturi scrubbers.

#### Topic 4. Apparatus for treatment of emissions from vapour and gaseous harmful substances

Features of emissions treatment from vapour and gaseous pollutants. Classification and characteristics of treatment methods. Types and designs of absorbers. Characteristics and design of adsorbers. Contact apparatus with different types of catalyst. Innovative developments in gas emissions treatment technology.

#### Topic 5. Settling and filtration of wastewater.

Features of mechanical wastewater treatment. Sand catchers. Constructions of different types of settling tanks. Classification and general characteristics of filters. Drum filters. Granular load filters. Other types of filters.

#### Topic 6. Equipment for wastewater treatment from suspended substances in the field of centrifugal forces.

Hydrocyclones and features of their use for wastewater treatment. Centrifuges are settling and filtering.

**Topic 7. Equipment for the removal of colloidal dispersed systems and emulsions from wastewater**  
Equipment for coagulation and flocculation. Characteristics of installations and flotators for wastewater treatment. Flotation coagulators.

**Topic 8. Wastewater treatment apparatus for removing dissolved impurities.**

Wastewater treatment in adsorbers. Ion exchange wastewater treatment using various types of apparatus. Membrane water treatment systems and their design. Extraction treatment of wastewater.

**Topic 9. Electrochemical and chemical methods of wastewater treatment.**

General characteristics of treatment apparatus. Designs of electroflotators and electrocoagulators. Characteristics of electrodialysers and their designs. Features of chemical wastewater treatment.

**Topic 10. Biological wastewater treatment systems.**

Technologies for biological treatment of industrial and domestic water. Structures and devices for biological wastewater treatment in artificial conditions. Design of aerators. Oxytanks. Biological filters. Treatment and disposal of sewage treatment plant sludge.

## Topics of the workshops

**Topic 1. Calculation of apparatus for dry treatment of emissions from dust.**

**Topic 2. Determining the main characteristics of scrubbers for removing dust from emissions.**

**Topic 3. Calculation of mechanical wastewater treatment facilities.**

**Topic 4. Equipment for physical and chemical wastewater treatment and their calculation.**

**Topic 5. Apparatus for the treatment of contaminated water by electrochemical methods.**

**Topic 6. Calculation of the aerotank.**

## Topics of the laboratory classes

Laboratory work is not provided in the course.

## Self-study

The course project involves students' personal search for information, analysis and creative approach to the development of modern emission and discharge treatment systems, as well as the selection and justification of treatment equipment. For other types of independent work in this discipline, additional information materials are provided in various forms of its presentation.

## Course materials and recommended reading

### Compulsory

1. Suchasni tekhnolohii zakhystu atmosfery: navch. posib. dlia studentiv vyshchych navchalnykh zakladiv ekolohichnoho profilu /Ukl. Martynenko S.A. Kropyvnytskyi: TsNTU, 2019. 155 s.
2. Doroshchenko V.V., Kotsiuba I.H., Yelnikova T.O., Uvaieva O.I. Vodopidhotovka: navch. posib. Zhytomyr: Derzhavnyi universytet «Zhytomyrska politekhnika», 2020. 153 s.
3. Inzhenerna ekolohiia : pidruchnyk / V. M. Isaienko, K. O. Babikova, Yu. M. Satalkin, M. S. Romanov ; za zah. red. prof. V. M. Isaienka. 2-e vyd., aktualizovane na pryntsypakh spriannia stalomu innovatsiinomu rozvytku ta zasadakh synerhetychnoho i kompetentnisnoho pidkhodiv. Kyiv :NAU, 2019. 452 s.

### Recommended

1. Biekietov V. Ye., Yevtukhova H.P. Dzherela ta protsesy zabrudnennia atmosfery. Modul 1. Dzherela ta protsesy zabrudnennia atmosfery: konspekt lektsii dlia studentiv 3 kursu dennoi ta zaочноi form navchannia spetsialnosti 101 – Ekolohiia. Kharkiv : KhNUMH im. O. N. Beketova, 2019. 113 s.
2. Cherniakova O.I. Metody zakhystu atmosfery : konspekt lektsii. Odesa: ODEKU, 2019. 89 s.
3. Metodichni vkazivky do vykonannia kursovoho proiektu z kursu "Obladnannia zakhystu biosfery" [Elektronnyi resurs]: dlia studentiv spets. 101 "Ekolohiia" ta 183 "Tekhnolohii zakhystu navkolysnogo seredovyscha" usikh form navchannia / uklad.: N. M. Samoilenko [ta in.] ; Nats. tekhn. un-t "Kharkiv. politekhn. in-t". Elektron. tekst. dani. Kharkiv, 2022. 44 s.

## Assessment and grading

### Criteria for assessment of student performance, and the final score structure

100% of the final grade consists of the results of the exam (40%) and the semester assessments (60%).  
Exam: written assignment and oral report. Current assessment: completion of a course project - 20% and two semester tests - 20% each

### Grading scale

Total points	National	ECTS
90-100	Excellent	A
82-89	Good	B
75-81	Good	C
64-74	Satisfactory	D
60-63	Satisfactory	E
35-59	Unsatisfactory (requires additional learning)	FX
1-34	Unsatisfactory (requires repetition of the course)	F

## Norms of academic integrity and course policy

The student must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": to demonstrate discipline, good manners, kindness, honesty, and responsibility. Conflict situations should be openly discussed in academic groups with a lecturer, and if it is impossible to resolve the conflict, they should be brought to the attention of the Institute's management.

Regulatory and legal documents related to the implementation of the principles of academic integrity at NTU "KhPI" are available on the website: <http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/>

## Approval

Approved by

Date, signature  
2023/08/31



Head of the department  
Oleksii SHESTOPALOV

Date, signature  
2023/08/31



Guarantor of the educational program  
Musii TSEITLIN