Syllabus
Course Program

Scientific Research and Modelling in Ecology

Specialty
101 – Ecology

Institute
Institute of Chemical Technology and Engineering

Educational program
Engineering ecology

Department
Integrated technologies, processes and apparatuses (191)

Level of education
Master's level

Course type
Special (professional), Mandatory

Semester
2

Language of instruction
English

Lecturers and course developers

Yury Selikhov

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PhD. in engineering, associate professor, professor of the department of Integrated technologies, processes and apparatuses of NTU "KhPI".

Author and co-author of more than 300 publications in scientific professional journals of Ukraine and in foreign scientific journals indexed by Scopus and Web of Science. Co-author of 15 methodical manuals and 23 patents of Ukraine.
Member of the Ukrainian association of chemical and food engineering (CFE-UA), which is a structural component of the European federation of chemical engineering EFCE.

Leading lecturer of the courses:
"Non-traditional and renewable energy sources";
"Fundamentals of energy-efficient technologies in industry";
"Fundamentals of measurement, diagnostics and reliability of technological systems";
"Scientific research and modeling in ecology".

Other courses of the teacher:
"Energy-saving processes and technologies in the design of environmentally friendly production facilities";
"Special sections for heat and mass transfer";
"Special sections of thermal physics"

More about the lecturer on the department's website

Anton Myronov

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PhD. in engineering, associate professor, associate professor of the department of oil, gas and condensate production of NTU "KhPI".

Author and co-author of more than 50 publications in scientific professional journals of Ukraine and in foreign scientific journals indexed by Scopus and Web of Science. Co-author of 4 methodical manuals and 9 patents of Ukraine for utility models.
Member of the Ukrainian association of chemical and food engineering (CFE-UA), which is a structural component of the European federation of chemical engineering EFCE.
Has a certificate confirming English language proficiency at B2 (Upper-Intermediate level).

Leading lecturer of the courses:
"Technical means of processing text and graphic information";
"Environmental economics";
"Computer-integrated technologies";
"Software of computer-integrated systems";
"Modern technologies in the industry";
"Design of computer-integrated systems of chemical technologies".

Other courses of the teacher:
"Computational mathematics and programming" (in Ukrainian and English);
"Information technology for chemical engineering";
"Heat and power integration of renewable sources and secondary energy resources into industrial processes";
"Computer-aided design of industrial equipment",
"Automated equipment design system in oil and gas industry".

More about the lecturer on the department's website

Kostiantyn Horbunov

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PhD. in engineering, associate professor, head of the department of oil, gas and condensate production of NTU "KhPI".

Author and co-author of more than 90 publications in scientific professional journals of Ukraine and in foreign scientific journals indexed by Scopus and Web of Science. Co-author of 15 methodical manuals.
Member of the Ukrainian association of chemical and food engineering (CFE-UA), which is a structural component of the European federation of chemical engineering EFCE.
Has a certificate confirming English language proficiency at B2 (Upper-Intermediate level).

Leading lecturer of the courses:
"Processes and devices of chemical production";
"Design and calculation of heat exchange equipment".

More about the lecturer on the department's website

General information

Summary

The ability to use computer technologies in the process of solving tasks of environmental protection, processing environmental information using the methods of computational mathematics. To know the latest methods and instrumental means of ecological research, including methods and means of mathematical and geo-informational modeling. Knowledge in the field of informatics and modern information technologies in the amount necessary for use in the chosen profession.

Course objectives and goals

To form students' concepts and provide knowledge about emissions of polluting substances by industrial enterprises into the atmosphere; on methods of: calculation of atmospheric pollution by emissions of harmful substances from point and linear emission sources; flare emission; groups of sources; site sources; development of projects of sanitary and protective zones of enterprises; modeling processes of emissions of polluting substances into the environment.

Format of classes

Lectures, laboratory classes, consultations, calculation tasks, self-study. Final control in the form of an exam.

Competencies

GC-1. The ability to learn and master modern knowledge.
GC-6. Competence to search, process, and analyze information from various sources.
SC-1. Awareness of the latest achievements necessary for research and/or innovation in the field of ecology, environmental protection, and sustainable use of natural resources.
SC-2. Ability to apply interdisciplinary approaches in critically analyzing ecological problems.
SC-4. Ability to apply new approaches to analyzing and predicting complex phenomena, and critically evaluating problems in professional activities.
SC-5. Ability to present knowledge and personal conclusions to both experts and non-experts.

Learning outcomes

RE-1. Know and understand the fundamental and applied aspects of environmental sciences.
RE-6. Know the latest methods and tools of environmental research, including methods and tools of mathematical and geoinformational modeling.
RE-8. Be able to clearly and unambiguously convey professional knowledge, own reasoning, and conclusions to specialists and the general public.
RE-18. Be able to use modern methods of information processing and interpretation in innovative activities.

Student workload

The total volume of the course is 120 hours (4 ECTS credits): lectures – 32 hours, laboratory classes – 16 hours, self-study – 72 hours.

Course prerequisites

To successfully complete the course, you must have knowledge and practical skills in the following disciplines: "Technological and environmental safety management".

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

Lectures are conducted interactively using multimedia technologies. In laboratory work, a distance course in the Mathcad programming environment.

Program of the course

Topics of the lectures

Topic 1.
Subject and tasks of the discipline.
The main directions of development of the subject.
Some information about the Earth's atmosphere.
Topic 2.
The structure of the atmosphere and the change in temperature with height.
Temperature inversion. Movement of air masses.
Wind and its effect on houses.
Topic 3.
Zones of support and aerodynamic shadow near a single building.
Classification of buildings and circulation zones.
Calculation of dispersion of harmful substances from single point sources.
Topic 4.
Dispersion of harmful substances from point sources with different variants of their location.
Topic 5.
Calculation of the dispersion of harmful substances from a single point source located on the roof of a wide building.
Topic 6.
Dispersion of harmful substances from a single point source over the windward circulation zone.
Topic 7.
Calculation of dispersion of harmful substances from flare emission.
Topic 8.
Atmospheric pollution taking into account the summation of harmful effects.
Topic 9.
Determining the minimum height of emission sources.
How to apply the standards of MPC for various atmospheric pollution by harmful substances.
Topic 10.
Establishing maximum permissible emissions of harmful substances in the atmosphere.
Determining the limits of the sanitary protection zone of the enterprise.
Topic 11.
Calculation of atmospheric pollution by emissions from various sources.
Topic 12.
Methodology for calculating the main parameters of emissions of harmful substances from single sources with the same parameters.
Topic 13.
Methodology for calculating the main parameters of emissions of harmful substances from single sources with different parameters.
Topic 14.
Methodology for calculating the main parameters of emissions of harmful substances from single sources with different parameters grouped on the site.
Topic 15.
Determination of the main indicators of emissions of harmful substances from site sources.
Topic 16.
Map of working conditions.

Topics of the workshops

Workshops within the course are not provided.

Topics of the laboratory classes

Laboratory class 1.
Calculation of the scattering of pollutants from an unshaded cold point source.

Laboratory class 2.
Calculation of the dispersion of harmful substances from a point source located on the roof of a narrow building.
Laboratory class 3.
Calculation of the dispersion of harmful substances from a linear emission source located on the roof of a narrow building.
Laboratory class 5.
Calculation of the dispersion of harmful substances from a point source located on the roof of a wide building in the windward circulation zone.
Laboratory class 6.
Calculation of the dispersion of harmful substances from a point source located on the roof of a wide building outside the windward circulation zone.
Laboratory class 7.
Calculation of the dispersion of harmful substances from a linear emission source located on the surface of the earth in a single circulation zone.
Laboratory class 8.
Calculation of dispersion of harmful substances from flare emission.

Self-study

The course involves the implementation of an individual calculation task on modeling in the Mathcad programming environment. The results of calculations and modeling are drawn up in a written report. Students are also recommended additional materials (videos, articles) for independent study and analysis.

Course materials and recommended reading

1. Sarah P.Otto and Troy Day. A Biologist's Guide to Mathematical Model / Princeton University Press – Princeton, New Jersey, – 2021 – 886 p.
https://drive.google.com/file/d/1-3BMMDQtNjSJFBCQckBQMCCYIWRHYKBH/view?usp=drive_link
2. Andrew D. Wilson. Ecological Mechanistic Research and Modelling // Ecological Mechanistic Research and Modelling, Ecological Psychology, 34:1-2, 48-70 pp.
https://drive.google.com/file/d/1WUMNpP65XP5UXPgITo28b7H9MGpbz5bh/view?usp=drive_link
3. Ben Bolker. Ecological Models and Data in R / Princeton University Press: Princeton and Oxford – 516 p.
https://drive.google.com/file/d/12PGWnw-bl06pIhGXwJbcbKr2ZrgJwKh-/view?usp=drive_link .

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 (10%) and the current assessment (90%).

Exam: written assignment (2 questions on theory and 2 tasks on drawing and three-dimensional modeling) followed by an oral answer.

Current assessment: 2 online quizzes (10% each), an online theory test (10%) and a calculation task (60%), followed by defense of the results (if needed)

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

Acting head of the department
Anton MYRONOV

2023/08/31

Guarantor of the educational program
Musii TSEITLIN

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