



Syllabus Course Program



Theory of Systems in Ecology

Specialty

101 – Ecology

Institute

Education and Science Institute of Mechanical Engineering and Transport

Educational program

Engineering ecology

Department

Chemical Engineering and Environment Protection (154)

Level of education

Master's level

Course type

Optional

Semester

2

Language of instruction

English, Ukrainian

Lecturers and course developers



Antonina Sakun

antonina.sakun@khpi.edu.ua

Ph.D., Associated Professor

Work experience - 4 years. Leading lecturer in the disciplines: "General ecology", "Normalization of anthropogenic load on the environment" and "Waste management systems", author and co-author of more than 40 scientific publications. Fluent in English and Ukrainian languages.

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

General information

Summary

The course outlines the basics of systems theory and system analysis, which are necessary during the study of various interdisciplinary problems, their system-synergistic bases and connections, as well as theoretical, methodical and practical issues of solving specific ecologically oriented tasks using a general system approach and methods of system analysis ecological processes.

Course objectives and goals

Formation of basic knowledge about the relationship and patterns of interaction of all components environment among themselves as part of ecological systems of all structural and functional levels organizations of the biosphere.

Format of classes

Lectures, practical classes, consultations. Individual calculation task. Final control - tests.

Competencies

The ability to use theoretical, methodical and practical solutions to specific issues environmentally oriented tasks using a general system approach and methods system analysis of ecological processes.

Learning outcomes

Apply the basics of systems theory and systems analysis, which are necessary during the study of various interdisciplinary problems, their system-synergistic foundations and connections.

Student workload

Total scope of the discipline: 2 semester - 90 hours (3 ECTS credits): lectures - 16 hours, practical classes – 16 hours, independent work – 58 hours.

Course prerequisites

Successful completion of the course requires mastery of competencies and results training provided by the standard of higher education in the specialty 101 "Ecology" of the first bachelor's level, as well as general knowledge of natural sciences.

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

Lectures are conducted in an interactive mode of communication with students and with use multimedia technologies. The reproductive method is used in practical classes training aimed at harmonizing the theoretical aspects of the course with practical ones and provides engineering and environmental calculations. When performing an individual task, it is used motivational method of teaching with the organization of independent activity of students in relation to ability analyze ecological systems and use methods of system analysis in general.

Program of the course

Topics of the lectures

Topic 1. Basic provisions of the general theory of systems.

The history of the development of the doctrine of systems. Connection of systems theory with other sciences

Topic2. Concept of system

Properties of systems. Classification of systems

Topic3. System analysis and system approach as research methodologies systems

Complexity of ecological systems

Topic4. Structural and functional levels of organization of the organic world

Degrees of organization of ecosystems. Consortium ecosystems. Landscape ecosystems.

Topic5. Energy balance of ecological systems and their productivity

Energy balance of ecological systems. Biological productivity of ecological systems.

Topic6. Environmental factors and their influence on the vital activity of organisms

The concept of environmental factors. Classification of environmental factors and their impact on living organisms.

Topic7. Natural dynamics and evolution of ecosystems

Ecological succession. Evolution of ecosystems. Ecosystem fluctuations.

Topic8. Methods of system analysis

Informal methods. Formalized methods.

Topic9. Peculiarities of mathematical modeling of ecological processes

Models of ecological systems described by one differential equation.

Topics of the workshops

Topic1. Systemic analysis of biotechnocenosis self-cleaning

Topic2. Modeling of dynamics of population

Topic3. PEST and SWOT analysis in the management of ecological systems

Topic4. Patterns of functioning of ecological systems

Topics of the laboratory classes

Laboratory work within the discipline is not provided.

Self-study

The discipline provides for the implementation of individual calculation according to options. Result calculations are drawn up in a written report. To perform other types of independent work additional information materials are offered.

Course materials and recommended reading

1. Chen YP, Chan ATC, Le QT, Blanchard P, Sun Y, Ma J. Nasopharyngeal carcinoma. *Lancet*. 2019;394:64–80.
2. Su ZY, Siak PY, Leong CO, Cheah SC. Nasopharyngeal Carcinoma and Its Microenvironment: Past, Current, and Future Perspectives. *Front Oncol*. 2022
3. Jiang J, Ying H. Revealing the crosstalk between nasopharyngeal carcinoma and immune cells in the tumor microenvironment. *J Exp Clin Cancer Res*. 2022.
4. Xie L, Shi F, Li Y, Li W, Yu X, Zhao L. et al. Drp1-dependent remodeling of mitochondrial morphology triggered by EBV-LMP1 increases cisplatin resistance. *Signal Transduct Target Ther*. 2020.
5. Kyrochristos ID, Ziogas DE, Roukos DH. Drug resistance: origins, evolution and characterization of genomic clones and the tumor ecosystem to optimize precise individualized therapy. *Drug Discov Today*. 2019.
6. Jin S, Li R, Chen MY, Yu C, Tang LQ, Liu YM. et al. Single-cell transcriptomic analysis defines the interplay between tumor cells, viral infection, and the microenvironment in nasopharyngeal carcinoma. *Cell Res*. 2020.
7. Liu Y, He S, Wang XL, Peng W, Chen QY, Chi DM. et al. Tumour heterogeneity and intercellular networks of nasopharyngeal carcinoma at single cell resolution. *Nat Commun*. 2021.
8. Gong L, Kwong DL, Dai W, Wu P, Li S, Yan Q. et al. Comprehensive single-cell sequencing reveals the stromal dynamics and tumor-specific characteristics in the microenvironment of nasopharyngeal carcinoma. *Nat Commun*. 2021.
9. Chen YP, Yin JH, Li WF, Li HJ, Chen DP, Zhang CJ. et al. Single-cell transcriptomics reveals regulators underlying immune cell diversity and immune subtypes associated with prognosis in nasopharyngeal carcinoma. *Cell Res*. 2020.
10. Peng WS, Zhou X, Yan WB, Li YJ, Du CR, Wang XS. et al. Dissecting the heterogeneity of the microenvironment in primary and recurrent nasopharyngeal carcinomas using single-cell RNA sequencing. *Oncoimmunology*. 2022.
11. Frankenstein Z, Basanta D, Franco OE, Gao Y, Javier RA, Strand DW. et al. Stromal reactivity differentially drives tumour cell evolution and prostate cancer progression. *Nat Ecol Evol*. 2020.

Assessment and grading

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

100% of the final grade is made up of the results of the current assessment. Credit: practical works 20%, individual assignment 20%, two control papers 30% 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

2023/08/31



Head of the department
Oleksii SHESTOPALOV

2023/08/31



Guarantor of the educational program
Musii TSEITLIN