NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE
Department of Agroecology and Environmental Control

APPROVED
Faculty of Plant Protection,
Biotechnology and Ecology

"21"___05__2025_

CURRICULUM OF ACADEMIC DISCIPLINE
«Urban Ecology.»

Area of knowledge 10 Natural Sciences
Specialty 101 Ecology
Academic programme Ecology
Faculty of Plant Protection, Biotechnology and Ecology
Developed by: Associate Professor, PhD in Agricultural Sciences **L. Vagaliuk**

Kyiv – 2025

Description of the discipline «Urban Ecology»

The discipline aims to provide students with essential knowledge and practical skills for analyzing and managing urban environments through ecological principles, with a focus on sustainability, environmental health, and urban planning.

Within the course, students study:

• key ecological concepts relevant to urban systems (urban metabolism, energy and material flows, green infrastructure);
• urban climate, air and water quality, and noise pollution in the context of ecological health;
• land use planning, zoning, and the ecological impacts of urban expansion;
• assessment and management of urban biodiversity (urban flora and fauna, ecological corridors, ecosystem services);
• methods for monitoring environmental indicators in cities (GIS tools, remote sensing, bioindication);
• policies and frameworks for sustainable urban development (UN Sustainable Development Goals, EU urban environmental policy, local governance practices);
• resilience strategies for urban areas in the face of climate change, extreme weather, and environmental degradation.

This discipline integrates theoretical foundations with applied activities such as environmental fieldwork, mapping of urban green spaces, and ecological audits of city districts. It prepares students for careers in urban environmental planning, ecological consulting, environmental monitoring, and sustainable development policy.

Field of knowledge, specialty, educational program, educational degree		
Educational degree	Bachelor	
Specialty	101”Ecology”	
Educational program	Ecology	
Characteristics of the discipline		
Kind of the discipline	Elective	
Total number of hours	120	
Credit amount ECTS	4	
Number of content modules	2	
Course project (work) for availability)	-	
Form of control	Exam	
Indicators of academic discipline for full-time and part-time forms of education		
	Full-time	Part-time
Year of preparation (course)	4	
Semester	7	
Lectures	15	
Practical, seminar classes	30	
Laboratory classes	-	
Individual work	75	
Number of weekly classrooms hours for full-time study	3	

1. Aim, competences and expected learning outcomes of the discipline

The aim of the discipline «**Urban Ecology»** is to provide students with a comprehensive understanding of the ecological structure and functioning of urban ecosystems, the anthropogenic pressures influencing them, and the tools and approaches necessary for their sustainable development. The course is designed to cultivate critical thinking and interdisciplinary problem-solving skills by integrating ecological theory with practical applications in urban planning,

environmental monitoring, and public policy. Special attention is paid to the ecological consequences of urbanization, climate change adaptation, environmental justice, and the development of resilient urban infrastructure. Students will be encouraged to analyze real-world urban ecological problems, propose evidence-based solutions, and develop strategies for sustainable city management.

Competences acquired:

Integral competence (IC): The ability to solve complex specialized tasks and address practical problems in the field of ecology, environmental protection, and sustainable natural resource management, or in the course of study. This involves the application of fundamental theories and methods of environmental sciences and is characterized by complexity and uncertainty of conditions.

General competence (GC):

GC03. Ability to adapt and respond effectively in new or changing situations

GC20. Ability to apply the fundamental principles and components of environmental management

GC21. Ability to perform environmental monitoring and evaluate the present condition of the surrounding environment

Program Learning Outcomes (PLO):

PLO 04. To apply management principles underlying the environmental safety system

PLO 05. To know the conceptual foundations of monitoring and regulating anthropogenic impacts on the environment.

2. Programme and structure of the discipline

Names of content modules and topics	**Number of hours**									
	full-time					part-time				
	total	including				total	including			
		l.	p.	lab.	ind.		l.	p.	lab.	ind.
1	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*
Module 1. Foundations and Challenges of Urban Ecology										
Lecture 1. Introduction to Urban Ecology	17	2	5	-	10	14	2	-	2	10
Lecture 2: Urban Environmental Problems	17	2	5	-	10	12		-	2	20
Lecture 3. Classification of Urban Plantations of Ukraine	22,5	2,5	5	-	15	14	2	-	2	20
Total for the module 1	56,5	6,5	15	-	35	64	6	-	8	50
Module 2. Urban Green Infrastructure and Environmental Management										
Lecture 1. Urban Vegetation and Green Spaces	17	2	5	-	10	14	2	-	2	10
Lecture 2. Urban Waste Management	14	2	2	-	10	12		-	2	10
Lecture 3. Urban Microclimate	16	2	4	-	10	10				10
Lecture 4. Plant Improvement of the City	16,5	2,5	4	-	10	10				10
Total for the module 2	63,5	8,5	15	-	40	56	2	-	4	50
Total	120	15	30	-	75	120	8	-	12	100

3. Topics of lectures

No.	Topic	Hours

1	Lecture 1. Introduction to Urban Ecology	2
2	Lecture 2: Urban Environmental Problems	2
3	Lecture 3. Classification of Urban Plantations of Ukraine	2,5
4	Lecture 1. Urban Vegetation and Green Spaces	2
5	Lecture 2. Urban Waste Management	2
6	Lecture 3. Urban Microclimate	2
7	Lecture 4. Plant Improvement of the City	2,5
	Total	**15**

4. Topic of laboratory (practical, seminars) classes

№	Topic	Hours
1	Assessment of Air and Soil Pollution in Urban Areas	3
2	Identification of Sources and Extent of Urban Soil Pollution	3
3	Measurement of Urban Microclimate Parameters	3
4.	Identification and Analysis of Urban Heat Island Effect	3
5.	Analysis of Albedo of Various Urban Surfaces	3
6.	Assessment of Biodiversity in Urban Parks and Squares	3
7.	Determination of Urban Vegetation Structure and Ecological Function	3
8.	Calculation of Water Pollution Index (WPI) for Urban Water Bodies	3
9	Assessment of Potential Pollution from Stormwater Runoff	3
10	Identification of Main Types of Urban Green Zones	3
	Total	**30**

5. Topics of self-study

No.	Topic	Hours
1.	Assessment of the Impact of Vehicle Traffic on Air Pollution Levels in Urban Areas	5
2.	Study of the Structure and Functions of Urban Green Spaces in Improving Urban Microclimate	5
3.	Calculation of Water Pollution Index for Urban Water Bodies and Analysis of Possible Pollution Sources	5
4.	Evaluation of the Effectiveness of Different Plant Species in Urban Air Purification	5
5.	Analysis of Urban Heat Islands and Development of Mitigation Measures	5
6.	Study of Soil Pollution Dynamics in Urban Parks and Adjacent Areas	5
7.	Assessment of Anthropogenic Pressure on Urban Ecosystems Using SWOT Analysis	5
8.	Modeling Urban Stormwater Pollution and Proposals to Reduce Impact	5
9.	Investigation of the Impact of Urban Development on Biodiversity in Urban Ecosystems	5
10.	Development of Ecological Recommendations for Improving Urban Green Spaces Considering Local Conditions	5
11.	Analysis of Noise Pollution Sources and Their Effects on Urban Environment and Human Health	6
12.	Assessment of Urban Waste Management Practices and Their Environmental Impacts	5
13.	Study of the Role of Urban Vegetation in Carbon Sequestration and Climate Change Mitigation	5
14.	Evaluation of Light Pollution in Urban Areas and Its Ecological Consequences	5
15.	Assessment of the Impact of Urbanization on Surface Water Quality and Quantity	5
	Total	**75**

6. Methods of assessing expected learning outcomes:

- Oral or written questioning
- Exam
- Module tests
- Essays, presentations
- Calculations (individual assignments**)**
- Defense of practical works

7. Teaching methods*:*

- Verbal method (lecture, discussion, interview, etc.)
- Practical method (laboratory and practical classes)
- Visual method (illustration method, demonstration method)
- Working with educational and methodological literature (note-taking, summarizing, annotating, reviewing, writing essays)
- Video method (distance learning, multimedia, web-based formats, etc.)
- Independent work (completion of assignments)
- Individual research work of higher education students

8. Results assessment.

The student's knowledge is assessed by means of a 100-point scale converted into the national grades according to the "Exam and Credit Regulations at NULES of Ukraine" in force.

8.1. Distribution of points by types of educational activities

Educational activity	Results	Assessment
Module 1. Foundations and Challenges of Urban Ecology		
Practical work №1. Assessment of Air and Soil Pollution in Urban Areas	To develop practical skills in measuring and analyzing the levels of air and soil pollution in urban environments, identify main pollutants and their sources, and understand the implications of pollution for urban ecosystems and human health.	**14**
Practical work № 2. Identification of Sources and Extent of Urban Soil Pollution	To develop the ability to identify and assess the sources and spatial extent of soil pollution in urban areas using field observations and analytical methods, and to evaluate the potential risks posed by soil contaminants to urban ecosystems.	**13**
Practical work № 3. Measurement of Urban Microclimate Parameters	To gain practical experience in measuring and analyzing key urban microclimate parameters such as temperature, humidity, and solar radiation, and to understand their spatial variability within different urban environments.	**13**
Practical work № 4. Identification and Analysis of Urban Heat Island Effect	To develop the ability to detect, measure, and analyze the Urban Heat Island (UHI) effect, understanding its causes, spatial distribution, and environmental consequences within urban areas.	**15**
Practical work № 5. Analysis of Albedo of Various Urban Surfaces	To develop practical skills in measuring and analyzing the albedo (reflectivity) of different urban surfaces and understand its influence on urban microclimate and energy balance	**15**
Module control work 1.		**30**
Total for module 1	PLO 04, PLO 05.	**100**
Module 2. Urban Green Infrastructure and Environmental Management		

Practical work 6. Assessment of Biodiversity in Urban Parks and Squares	To develop skills in inventorying and assessing biodiversity within urban green spaces, focusing on the identification of key plant and animal species and evaluation of their ecological roles.	**14**
Practical work 7. Determination of Urban Vegetation Structure and Ecological Function	To develop the ability to analyze the structural characteristics of urban vegetation and assess its ecological functions within the urban environment.	**14**
Practical work 8.Calculation of Water Pollution Index (WPI) for Urban Water Bodies	To develop skills in calculating and interpreting the Water Pollution Index (WPI) to assess the ecological status of urban water bodies based on available chemical and biological data.	**14**
Practical work 9.Assessment of Potential Pollution from Stormwater Runoff	To develop the ability to evaluate the potential pollution load from stormwater runoff in urban areas by analyzing catchment characteristics and runoff coefficients.	**14**
Practical work 10. Identification of Main Types of Urban Green Zones	To develop practical skills in identifying, classifying, and mapping the primary types of urban green zones, understanding their characteristics and ecological significance within the urban landscape.	**14**
Module control work 2.		
Total for module 2	PLO 04, PLO 05	**100**
Class work		**(M1 + M2)/2*0,7 ≤ 70**
Exam/credit		**30**
Total for year		**(Class work + exam) ≤ 100**

8.2. Scale for assessing student's knowledge

Student's rating, points	National grading (exam/credits)
90-100	excellent
74-89	good
60-73	satisfactory
0-59	unsatisfactory

8.3. Assessment policy

Deadlines and exam retaking rules	*EXAMPLE:* works that are submitted late without valid reasons will be assessed with a lower grade. Module tests may be retaken with the permission of the lecturer if there are valid reasons (e.g. a sick leave).
Academic integrity rules	*EXAMPLE:* cheating during tests and exams is prohibited (including using mobile devices). Term papers and essays must have correct references to the literature used
Attendance rules	*EXAMPLE:* Attendance is compulsory. For good reasons (e.g. illness, international internship), training can take place individually (online by the faculty dean's consent)

9. Teaching and learning aids:

- e-learning course of the discipline (https://elearn.nubip.edu.ua/course/view.php?id=2622 *)*
- references to digital educational resources;
- textbooks, manuals, tutorials;

- guidelines for studying a discipline by full-time and part-time students;
- internship programmes of the discipline (if included in the curriculum)

1. Rubezhniak, O. (2020). *Urban Ecology: Principles and Practices*. Kyiv: Publishing House "Naukova Dumka".
2. Chaika, V. M., Rubezhniak, I. H., & Minyailo, A. A. (2015). *Ecology of Urban Ecosystems (Urban Ecology)*. Kyiv: Komprint.

10. Recommended sources of information

1. McDonnell, M. J., & Hahs, A. K. (2015). *The Ecology of Cities and Towns: A Comparative Approach* (2nd ed.). Cambridge University Press. https://doi.org/10.1017/CBO9781139019253
2. Grimm, N. B., Faeth, S. H., Golubiewski, N. E., Redman, C. L., Wu, J., Bai, X., & Briggs, J. M. (2008). Global Change and the Ecology of Cities. *Science*, 319(5864), 756–760. https://doi.org/10.1126/science.1150195
3. Pickett, S. T. A., Cadenasso, M. L., & Grove, J. M. (2011). Urban Ecology: Science of Cities. *Science*, 333(6044), 1384–1385. https://doi.org/10.1126/science.1204436
4. Alberti, M. (2016). *Cities That Think Like Planets: Complexity, Resilience, and Innovation in Hybrid Ecosystems*. University of Washington Press.
5. Niemelä, J. (2014). Ecology of Urban Green Spaces: The Way Forward in Building Sustainable Cities. *Landscape and Urban Planning*, 125, 210–215. https://doi.org/10.1016/j.landurbplan.2014.01.018
6. Forman, R. T. T. (2014). *Urban Ecology: Science of Cities*. Cambridge University Press.
7. Andersson, E., Barthel, S., & Borgström, S. (2014). Resilience Thinking in Urban Ecology: Linking Urban Resilience to Urban Ecosystem Services. *Ecology and Society*, 19(4), 1–14. https://doi.org/10.5751/ES-06843-190414
8. Elmqvist, T., Fragkias, M., Goodness, J., Güneralp, B., Marcotullio, P. J., McDonald, R. I., ... & Wilkinson, C. (Eds.). (2013). *Urbanization, Biodiversity and Ecosystem Services: Challenges and Opportunities*. Springer. https://doi.org/10.1007/978-94-007-7088-1
9. Shaffer, L. J., & Smith, M. J. (2021). Urban Ecology in the Anthropocene: A Global Perspective. *Frontiers in Ecology and the Environment*, 19(6), 321–329. https://doi.org/10.1002/fee.2310
10. United Nations. (2022). *World Urbanization Prospects: The 2022 Revision*. Department of Economic and Social Affairs, Population Division. https://population.un.org/wup/