

	МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ	СУ СМЯ НУБіП України 7.5-072-05
	НАЦІОНАЛЬНИЙ УНІВЕРСИТЕТ БІОРЕСУРСІВ І ПРИРОДОКОРИСТУВАННЯ УКРАЇНИ	Введено в дію: Наказ № _____
	«Положення про робочу програму навчальної дисципліни»	від _____

NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE

Department of Geoinformatics and Aerospace Research of the Earth

APPROVED
Faculty of Land Management

May 15, 2025

CURRICULUM OF ACADEMIC DISCIPLINE

REMOTE SENSING FOR LAND RESOURCES MONITORING

Area of knowledge	<u>19. Architecture and Construction</u>
Specialty	<u>193. Geodesy and Land Management</u>
Academic programme	<u>"Geodesy and Land Management"</u>
Faculty	<u>Land Management</u>
Developed by:	<u>Associate Professor, PhD Antonina Moskalenko</u>
	<u>Assistant Professor, PhD Anastasiia Horodnycha</u>
	(position, academic degree, academic title)

Kyiv – 2025

Description of the discipline

The academic discipline "Remote sensing for land resources monitoring" is a mandatory component of the educational program. The course develops students' competencies in the basics of remote monitoring of land resources.

During the course, students master the basics of visual decoding of satellite images, classification of remote sensing methods, types of sensor systems and remote sensing sensors of low, medium and high spatial resolution, their application to solve problems of remote monitoring of land resources. They study the possibilities of obtaining free data from open websites, the procedure for ordering commercial remote sensing data and their data formats, methods of obtaining data based on unmanned aerial vehicles (UAVs).

Training is conducted by specialists of the "Department of Geoinformatics and Aerospace Research of the Earth" in specially equipped computer classrooms using developed methodological materials for digital processing of remote sensing data using free and licensed images obtained for educational and scientific purposes.

Area of knowledge, specialty, academic programme, academic degree		
Academic degree	Bachelor`s	
Specialty	193. Geodesy and Land Management	
Academic programme	Geodesy and Land Management	
Characteristics of the discipline		
Type	Required	
Total number of hours	120	
Number of ECTS credits	4	
Number of modules	2	
Course project (work) (if any)	-	
Form of assessment	Credit	
Indicators of the discipline for full-time and part-time forms of university study		
	University study	
	Full-time	Part-time
Year of study	4	3-4
Term	7	6-7
Lectures	3 hours	2 hours
Practical classes and seminars	-	-
Laboratory classes	30 hours	-
Self-study	75 hours	-
Number of hours per week for full-time students	3 hours	-

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

The aim is to form students' knowledge of the theoretical principles of remote sensing of the Earth (RES) and acquire practical skills in preliminary and thematic processing of remote sensing data for use in land management and land cadastre, and to ensure remote monitoring of land resources.

Competences acquired:

Integral competence (IC):

The ability to solve complex specialized problems in geodesy and land management.

General competence (GC):

- GC01. Ability to learn and master modern knowledge.
- GC02. Ability to apply knowledge in practical situations.
- GC05. Ability to communicate in a foreign language.
- GC06. Ability to use information and communication technologies.
- GC07. Ability to work autonomously.
- GC08. Ability to work in a team.
- GC10. Ability to perform safe activities.
- GC12. Ability to exercise one's rights and responsibilities as a member of society; awareness of the value of civil (free democratic) society and the need for its sustainable development, the rule of law, and the rights and freedoms of man and citizen in Ukraine.
- GC13. The ability to preserve and multiply moral, cultural, scientific values and achievements of society based on understanding the history, patterns of development of the subject area, its place in the general system of knowledge about nature and society, as well as in the development of society, technology and engineering, to use various types and forms of physical activity for recreation and leading a healthy lifestyle.

Special (professional) competence (SC):

- SC01. Ability to apply fundamental knowledge to analyze phenomena of natural and man-made origin when performing professional tasks in the field of geodesy and land management.
- SC02. Ability to apply theories, principles, and methods of physical, mathematical, natural, socio-economic, and engineering sciences when performing geodesy and land management tasks.
- SC03. Ability to apply regulatory legal acts, regulatory and technical documents, reference materials in professional activities.
- SC04. Ability to select and use effective methods, technologies and equipment for carrying out professional activities in the field of geodesy and land management.
- SC05. Ability to apply modern information, technical and technological support to solve complex issues of geodesy and land management.
- SC06. Ability to perform remote, ground, field and office research, engineering calculations for processing research results, formalize research results, prepare reports when solving geodesy and land management tasks.
- SC07. Ability to collect, update, process, critically evaluate, interpret, store, publish and use geospatial data and metadata regarding objects of natural and man-made origin.
- SC08. Ability to carry out professional activities in the field of geodesy and land management, taking into account the requirements of professional and civil safety, labor protection, social, environmental, ethical, and economic aspects.
- SC09. Ability to use tools, devices, equipment, and facilities when performing geodesy and land management tasks.
- SC10. Ability to monitor and assess land.
- SC11. Ability to carry out geodetic monitoring of the earth's surface, natural objects, and engineering structures.
- SC12. Ability to conduct technical control and assess the quality of topographic, geodetic and cartographic products.
- SC13. Ability to develop documentation on land management and land valuation, cadastral documentation, and fill in data for state land, urban planning, and other cadastres.

Expected learning outcomes (ELO):

Topic 2. Image georeferencing and image transformation	10	13	1		2		10						
Topic 3. Image acquisition based on Unmanned Aerial Vehicles (UAVs)	11-12	12	2		2		10						
Topic 4. Image Classification	13-15	28	2		8		18						
Total for module 2	60		7		15		38						
Total hours	120		15		30		75	2	2				

3. Topics of lectures

№	Topic	Hours
1	Introduction. Concepts of remote sensing of the Earth. Electromagnetic radiation	2
2	Visual interpretation of objects	2
3	Classification of methods of remote sensing. Sensor systems	2
4	Image acquisition. Data formats. Standards in remote sensing	2
5	Preprocessing of remotely sensed data	2
6	Image georeferencing and image transformation	1
7	Image acquisition based on Unmanned Aerial Vehicles (UAVs)	2
8	Image Classification	2
	Total	15

4. Topics of laboratory classes

№	Topic	Hours
1	Visual interpretation of image elements in various spectral channels. Interpretation of recognized objects	8
2	Measurement of spectral brightness of objects	4
3	Radiometric image enhancement	3
4	Image resampling	2
5	Unsupervised classification	3
6	Training sites. Signature comparison chart	3
7	The quality of training sites. Application of algorithms of image classification based on hard rules	7
	Total	30

5. Topics of self-study

№	Topic	Hours
1	Professional terminology in remote sensing of the Earth	10
2	Image interpretation	10
3	Remote sensing data acquisition	10
4	Image georeferencing and image transformation	7
5	Preprocessing of remotely sensed data	10
6	Image acquisition based on Unmanned Aerial Vehicles (UAVs)	10
7	Image Classification	18
	Total	75

6. Methods and means of diagnosing learning outcomes:

- oral or written survey;
- discussions;
- speech with presentations;
- testing;
- defense of laboratory work;
- defense of essays.

7. Teaching methods:

- problem-based learning;
- practice-oriented studying method;
- case method;
- visual method;
- flipped classroom;
- learning through research;
- video method;
- self-study work.

8. Results assessment.

The knowledge of a higher education applicant is assessed on a 100-point scale and is converted into a national assessment in accordance with the current "Regulations on Examinations and Tests at the NUBiP of Ukraine"

8.1. Distribution of points by types of educational activities

Educational activity	Results	Assessment
Module 1. Concept of remote sensing		
Topic 1. Introduction. Concepts of remote sensing of the Earth. Electromagnetic radiation		
Laboratory work 1. part 1. Visual interpretation of image elements in various spectral channels. Interpretation of recognized objects	To know the classification of methods of remote sensing, atmospheric radiative window and the spectral ranges (bands) used in RS; To understand differences between the reflectance and coefficient of reflectance. ELO01; ELO02; ELO04; ELO07; ELO09; ELO11; ELO13; ELO15	5
Laboratory work 1. part 2. Visual interpretation of image elements in various spectral channels. Interpretation of recognized objects		5
Laboratory work 1. part 3. Visual interpretation of image elements in various spectral channels. Interpretation of recognized objects		10
Laboratory work 1. part 4. Visual interpretation of image elements in various spectral channels. Interpretation of recognized objects		10
Self-study 1. Professional terminology in remote sensing of the Earth		5
Topic 2. Visual interpretation of objects		
Laboratory work 2. Measurement of spectral brightness of objects	To know the direct elements of image interpretation and direct recognition, geometric, brightness's, structural elements of visual image interpretation; To distinguish structural, geometric and spectral characteristics of objects ELO02; ELO04; ELO09; ELO12; ELO13	10
Self-study 2. Image interpretation		5
Topic 3. Classification of methods of remote sensing. Sensor system		
Self-study 3. Remote sensing data acquisition	To know classification of remote sensing methods; To be acquainted with low- medium-, highspatial resolution sensor systems and their use for solving problems of land monitoring ELO04; ELO07; ELO09; ELO10	5
Topic 4. Image acquisition. Data formats. Standards in remote sensing		

Laboratory work 3. Radiometric image enhancemen	To know main formats of deliverable remote sensing data and data processing levels; To analyze the possibilities of using high spatial resolution sensors and data obtained from UAVs. ELO02; ELO04; ELO07; ELO09; ELO12	10
Self-study 4. Image georeferencing and image transformation		5
Module control work 1.		30
Total for module 1		100
Module 2. Digital image analysis		
Topic 1. Preprocessing of remotely sensed data		
Laboratory work 4. Image resampling	To know the main groups of operations for digital image processing: image restoration (correction), radiometric correction of digital imagine (radiance, radiometric correction of the atmosphere, image resampling and geometric correction); To distinguish the peculiarities of the use of methods for image atmospheric correction. ELO01; ELO02; ELO09; ELO11	10
Topic 2. Image georeferencing and image transformation		
Laboratory work 5. Unsupervised classification	To know the basis of image geometric transformation; To be able to choosing control points; To use different methods of image transformation. ELO07; ELO09; ELO12	15
Self-study 5. Preprocessing of remotely sensed data		5
Topic 3. Image acquisition based on Unmanned Aerial Vehicles (UAVs)		
Laboratory work 6. Training sites. Signature comparison char	To know the basics of the UAV application in mapping to obtain a geodetic basis for cadastral activities, to ken the main characteristics of multispectral cameras and cameras in the visible range; To be able to use data from multispectral cameras to solve problems of land monitoring. ELO01; ELO02; ELO12; ELO13	10
Self-study 6. Image acquisition based on Unmanned Aerial Vehicles (UAVs)		5
Topic 4. Image classification		
Laboratory work 7. The quality of training sites. Application of algorithms of image classification based on hard rules	To know the basis of image classification methods in remote sensing: unsupervised classification method (KMeans Classification, Isodata Classification), supervised classification methods (Parallelepiped Classification, Maximum Likelihood Classification, Minimum Distance Classification, Mahalanobis Distance Classification); To apply methods of supervised and unsupervised classification in thematic mapping of land resources. ELO01; ELO07; ELO09; ELO12	20
Self-study 7. Image classification		5
Module control work 2.		30
Total for module 2		100
Class work	(M1 + M2)/2*0.7 ≤ 70	
Credit	30	
Total for year	(Class work + Credit) ≤ 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	Works submitted after the deadline without good reason will be given a lower grade. Modules can be retaken with the permission of the lecturer if there are good reasons (for example, sick leave).
Academic integrity rules	Cheating during tests and exams is prohibited (including using mobile devices). Term papers and essays must have correct text references to the literature used
Attendance rules	at classes is mandatory. For objective reasons (e.g. illness, international internship), studies may be conducted individually (online upon agreement with the dean of the faculty).

9. Educational and methodological support:

- electronic educational course of the academic discipline - <https://elearn.nubip.edu.ua/enrol/index.php?id=1714>);
- lecture notes and their presentations (in electronic form - <https://elearn.nubip.edu.ua/enrol/index.php?id=1714>);
- textbooks, study guides, workshops;
- methodological materials for studying the academic discipline for full-time and part-time higher education students.

10. Recommended sources of information

Main:

1. Kokhan S., Vostokov A. Remote sensing methods. Textbook. K. TsP Komprint. 2021. 286 p.
2. A. Koshel, D. Koshel, O. Kempa. Geoinformation support for strategic planning and monitoring of regional development of Ukraine under martial law. <https://journals.indexcopernicus.com/api/file/viewByFileId/2098124>
3. Boyko A. & Shevchenko V. (2021). Using Sentinel-2 satellite data for monitoring vegetation cover under climate change. *Scientific Papers of the Alfred Nobel University. Series: Ecology* , 2(24), 45–52.
4. Lysenko S. & Koval N. (2020). GIS analysis and remote sensing in landscape planning. *Bulletin of the Taras Shevchenko National University of Kyiv. Geography* , 74(1), 34–41.
5. Sapozhnikov O. (2023). Integration of geoinformation technologies into ecological monitoring of water resources. *Ecological Safety and Balanced Resource Use* , 3(27), 88–96.

6. Gorbunov O. & Pylypenko I. (2022). Monitoring of agricultural lands using remote sensing and GIS data. *Scientific Bulletin of the B. Khmelnytskyi National University of Ukraine. Series: Geographical Sciences* , 14(2), 112–118.
7. Kucherenko Y. & Ilchenko T. (2020). GIS in monitoring urbanized areas: methodological approach and implementation examples. *Ukrainian Geographical Journal* , 2(108), 18–24.
8. Bondarenko O. & Rudenko S. (2021). Remote sensing of the Earth as a tool for rapid response to emergencies. *Problems of Emergency Situations* , 1(33), 56–63.
9. Shpylchak V. & Melnychuk M. (2023). Using remote sensing and GIS to monitor erosion processes in agrolandscapes of Western Ukraine. *Balanced Nature Management* , 1(19), 71–77.
10. Poltoratsky O. (2022). Geoinformation modeling of flooding risks within urbanized areas. *Scientific journal "Geoinformation Systems"* , 3(17), 43–50.
11. Mazur S. & Yatsenko I. (2021). Application of satellite imagery for the analysis of forest cover changes. *Forestry and Agroforestry Reclamation* , 139(1), 98–104.
12. Levchenko N. & Dyachenko A. (2024). GIS analysis as a tool for making management decisions in the field of urban planning. *Architecture and Environment* , 17(1), 50–58.
13. Dudnik A., Opryshko O., Kiktev M., Tsitsyurskyi Y., Zhuk D. Remote monitoring of agricultural fields with craters from explosive devices to restore their use for crop practices. *Energy and Automation*. - K.: NUBiP, 2024, No. 6 DOI: [http://dx.doi.org/10.31548/energiya4\(74\).2024.075](http://dx.doi.org/10.31548/energiya4(74).2024.075)

Auxiliary:

14. ISO 19101-1:2014 — Geographic information — Reference model — Part 1: Fundamentals. <https://www.iso.org/standard/59164.html>
15. ISO 19103:2024 — Geographic information — Conceptual schema language. <https://www.iso.org/standard/83454.html>
16. ISO 19107:2019 — Geographic information — Spatial schema. <https://www.iso.org/standard/66175.html>
17. ISO 19108:2002 — Geographic information — Temporal schema. <https://www.iso.org/standard/26013.html>
18. ISO 19109:2015 — Geographic information — Rules for application schema. <https://www.iso.org/standard/59193.html>
19. ISO 19110:2016 — Geographic information — Methodology for feature cataloguing. <https://www.iso.org/standard/57303.html>
20. ISO 19111:2019 — Geographic information — Referencing by coordinates. <https://www.iso.org/standard/74039.html>
21. ISO 19115-1:2014 — Geographic information — Metadata — Part 1: Fundamentals. <https://www.iso.org/standard/53798.html>
22. ISO 19117:2012 — Geographic information — Portrayal. <https://www.iso.org/standard/46226.html>
23. ISO 19123-1:2023 — Geographic information — Schema for coverage geometry and functions — Part 1: Fundamentals. <https://www.iso.org/standard/70743.html>
24. ISO 19125-1:2004 — Geographic information — Simple feature access — Part 1: Common architecture. <https://www.iso.org/standard/40114.html>

25. ISO 19128:2005 - Geographic information - Web map server interface.
<https://www.iso.org/standard/32546.html>
26. ISO 19133:2005 - Geographic information - Tracking and navigation.
<https://www.iso.org/standard/32551.html>
27. ISO 19135-1:2015 — Geographic information — Procedures for item registration — Part 1: Fundamentals. <https://www.iso.org/standard/54721.html>
28. ISO 19136-1:2020 — Geographic information — Geography Markup Language (GML) — Part 1: Fundamentals. <https://www.iso.org/standard/75676.html>
29. ISO 19139:2007 - Geographic information - Metadata - XML schema implementation.
<https://www.iso.org/standard/32557.html>
30. ISO 19142:2010 - Geographic information - Web Feature Service.
<https://www.iso.org/standard/42136.html>
31. ISO 19157:2013 — Geographic information — Data quality.
<https://www.iso.org/standard/32575.html>
32. ISO 19160-1:2015 — Addressing — Part 1: Conceptual model.
<https://www.iso.org/standard/61710.html>