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	19. Architecture and Construction
Specialty	193. Geodesy and Land Management
Academic programme	"Geodesy and Land Management"
Faculty	Land Management
Developed by:	Associate Professor, Candidate of Technical Sciences A. Moskalenko Assistant Professor, PhD A. Horodnycha (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*)**:

ELO01. Communicate freely in oral and written forms in the state and foreign languages on matters of professional activity.
ELO02. Organize and manage the professional development of individuals and groups.
ELO03. Communicate information, ideas, problems, solutions, own experience, and arguments to specialists and non-specialists.
ELO04. Know and apply in professional activities regulatory and legal acts, regulatory and technical documents, reference materials in the field of geodesy and land management and related industries.
ELO07. Perform survey and survey, topographic and geodetic, cartographic, design and design and survey work when performing professional tasks in geodesy and land management.
ELO09. Collect, evaluate, interpret and use geospatial data, metadata regarding objects of natural and man-made origin, apply statistical methods of their analysis to solve specialized problems in the field of geodesy and land management.
ELO10. Select and apply tools, equipment, facilities, and software necessary for remote, terrestrial, field, and desk-based research in the field of geodesy and land management.
ELO11. Organize and perform remote, ground, field and office work in the field of geodesy and land management, document the results of the work, and prepare relevant reports.
ELO12. Develop land management documentation, cadastral documentation and land valuation documentation using computer technologies, geographic information systems and digital photogrammetry, fill the state land, urban planning and other cadastres with data.
ELO13. Plan and perform geodetic, topographic and cadastral surveys, process the results obtained in geographic information systems.
ELO15. Develop and make effective decisions regarding professional activities in the field of geodesy and land management, including under conditions of uncertainty.

2. Program and structure of the discipline

– full-time study period
– shortened term of full-time (correspondence) study

Modules and topics	Number of hours												
	full-time							part-time					
	weeks	total	including					total	including				
			l	p	lab	ind	s.st.		l	p	lab	ind	s.st.
Module 1. General concept of remote sensing													
Topic 1. Introduction. Concepts of remote sensing of the Earth. Electromagnetic radiation	1-4	20	2		8		10						
Topic 2. Visual interpretation of objects	5-6	16	2		4		10	1	1				
Topic 3. Classification of methods of remote sensing. Sensor systems	7	12	2				10	1	1				
Topic 4. Image acquisition. Data formats. Standards in remote sensing	8	12	2		3		7						
Total for module 1	**60**		**8**		**15**		**37**	**2**	**2**				
Module 2. Digital image analysis													
Topic 1. Preprocessing of remotely sensed data	9-10	5	2		3								

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

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