

**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
GIS and DATABASES**

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 prof., PhD, Moskalenko A.A.

Kyiv – 2025

Description of the discipline The course "Geoinformation systems and databases" consists of topics related to fundamentals of GIS technologies and concepts of database theory; their architecture and stages of construction. The features of the hierarchical, network, relational and object-oriented database models are considered. The design of relational databases, relational algebra, functional dependencies and normalization, the basic elements of SQL and the use of ER-diagrams and UML for building database structures are studied. Students get practical experience in designing conceptual, logical and physical data models, attribute input into database, constructing spatial components of the vector-based topological model and queries application to the spatial components.

Aim of the discipline: The course "GIS and Database" provides the opportunity to use in program Purpose of the discipline: The discipline "GIS and databases" forms in students the ability to use in production software and technical complexes for automated accounting, storage, display, analysis, modeling of spatially coordinated information and the creation of databases in the field of land management, cadaster, geodesy and cartography.

Objectives of course the task of studying the discipline is the formation of a specialist's theoretical knowledge and practical skills in working with databases, the ability to organize the collection and selection of necessary data, the use of GIS for managing land resources when solving the tasks of land management, cadaster, geodesy and cartography.

Area of knowledge, specialty, academic programme, academic degree		
Academic degree	Bachelor	
Specialty	193 Geodesy and Land management	
Academic programme	Geodesy and Land management	
Characteristics of the discipline		
Type	Selected	
Total number of hours	120	
Number of ECTS credits	4	
Number of modules	2	
Course project (work) (if any)		
Form of assessment	Final test	
Indicators of the discipline for full-time and part-time forms of university study		
	University study	
	Full-time	Part-time
Year of study	3	
Term	6	
Lectures	15 hours.	
Practical classes and seminars	- hours.	
Laboratory classes	45 hours.	
Self-study	60 hours.	
Number of hours per week for full-time students	- hours.	

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

Aim The course "Digital plans and maps» provides obtaining skills of GIS cartographic modeling for land management and land cadaster.

Competences acquired:

Integral competence (IC):

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

General competence (GC):

GC 01. Ability to learn and master modern knowledge.

GC 02. Ability to apply knowledge in practical situations.

GC 05. Ability to communicate in a foreign language.

GC 06. Ability to use information and communication technologies.

GC 07. Ability to work autonomously.

GC 08. Ability to work in a team.

GC 13. Ability to preserve, multiply moral, cultural, scientific values and achievements of society based on understanding of 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 technology. activities for recreation and healthy living

Special (professional) competence (SC):

SC 01. Ability to apply fundamental knowledge to analyze phenomena of natural and man-made origin in the performance of professional tasks in the field of geodesy and land management.

SC 03. Ability to apply regulations, regulatory and technical documents, reference materials in professional activities.

SC 04. Ability to choose and use effective methods, technologies and equipment for professional activities in the field of geodesy and land management.

SC 05. Ability to use modern information, technical and technological support to address complex issues of geodesy and land management.

SC 06. Ability to perform remote, ground, field and in-house research, engineering calculations for processing research results, prepare research results, prepare reports in solving problems of geodesy and land management.

SC 07. Ability to collect, update, process, critically evaluate, interpret, store, publish and use geospatial data and metadata on objects of natural and man-made origin.

SC 08. 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, economic aspects.

SC 09. Ability to use tools, instruments, equipment, facilities in the performance of geodetic and land management tasks.

SC 10. Ability to monitor and evaluate land.

Expected learning outcomes (ELO):

ELO 1. Fluent in oral and written forms in state and foreign languages on professional matters.

ELO 2. Organize and manage the professional development of individuals and groups.

ELO 3. Communicate information, ideas, problems, solutions, personal experience and arguments to specialists and non-specialists.

ELO 4. To know and apply in professional activity normative-legal acts, normative-technical documents, reference materials in the field of geodesy and land management and related branches.

ELO 9. Collect, evaluate, interpret and use geospatial data, metadata on 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.

ELO 10. Choose and apply tools hardware, hardware and software supplies needed for remote, ground, field and in-house research in in the field of geodesy and land management.

ELO 11. Organize and execute remote, ground, field and camera works in the field of geodesy and land management, draw up the results of work, prepare relevant reports.

ELO 13. Plan and execute geodetic, topographic and cadastral surveys, process the results in geographic information systems.

ELO 14. Plan a complex professional activity, develop and implement projects in the field of geodesy and land management under conditions resource and other constraints.

ELO 15. Develop and adopt effective decisions on professional activities in the field geodesy and land management, including under conditions uncertainty.

2. Programme and structure of the discipline

Modules and topics	Hours											
	full-time study							correspondence				
	weeks	total	including					total	including			
			1	p	lab	ind	s.w.		1	p	lab	ind
1	2	3	4	5	6	7	8	9	10	11	12	13
SEMANTIC MODULE I. Basics of Geoinformation systems and technologies												
Theme 1. Introduction to Geoinformation science	1	10	2		4		4					
Theme 2. Model of spatial data: vector and object data models	2	10	2		4		4					
Theme 3. Model of spatial data. Mosaic models	3	10	2		4		4					
Total by Semantic module 1		30	6		12		12					
SEMANTIC MODULE II. Modern technology of databases, Normalization												
Theme 4. Basic concepts and determination of database theory	4	8	2		2		4					
Theme 5. Stages of database design	5	16	2		2		12					
Theme 6. Database system concepts and architecture	6	6	2		4							
Theme 7. Data modeling using the entity-relationship model	7	4	2		2							
Theme 8. Relational database design	8	16	2		4		10					
Theme 9. Normalization as way to control of database structure. Normal forms 1-3	9	4	2		2							
Theme 10. Normalization. The heist normal forms	10	6	2		4							
Total by Semantic module 1		60	14		20		26					
SEMANTIC MODULE IV. Operation with data												
Theme 11. Modern database methodology infological design	11-12	6	2		4							
Theme 12. Relational algebra	13	6	2		4							
Theme 13. Operation and query languages	14-15	18	6		5		7					
Total by Semantic module 2		30	10		13		7					
Усього годин		120	30		45		45					

3. Topics of lectures

No.	Topic	Hours
1	Introduction to Geoinformation science	2
2	Model of spatial data: vector and object data models.	2
3	Model of spatial data. Mosaic models	2
4	Basic concepts and determination of database theory	2
5	Stages of database design	2
6	Database system concepts and architecture	2

7	Data modeling using the entity-relationship model	2
8	Relational database design	2
9	Normalization as way to control of database structure. Normal forms 1-3	2
10	Normalization. The heist normal forms	2
11	Modern database methodology infological design	2
12	Relational algebra	2
13	Operation and query languages	6
Total		30

4. Topic of laboratory classes

№	<i>Topic</i>	Hours
1	Determination of the design boundary of the geospatial data base	2
2	Forming a technical task for designing a geospatial database	2
3	Create and convert geospatial data layers	2
4	Vectorization. Part 1	2
5	Vectorization. Part 2	2
6	Vectorization. Part 3.	2
7	Editing vector layers. Part 1	2
8	Editing vector layers. Part 2	2
9	Entering attribute data. Part 1	2
10	Entering attribute data. Part 2	2
11	Creation of a conceptual model of the database	2
12	Creating a logical database model. Part 1	2
13	Creating a logical database model. Part 2	2
14	Normalization. Part 1	2
15	Normalization. Part 2	2
16	Normalization. Part 3	2
17	Creating a physical database model	4
18	SQL query language. Part 1	2
19	SQL query language. Part 2	2
20	Calculation of secondary attributes of subject area objects. Creation of new object classes	2
21	Client-server architecture in the formation of requests to the database	3
Total		45

5. Topics of self-study

№	<i>Topic</i>	Hours
1	Analysis of publications on the basics of geoinformation systems and technologies	4
2	Creating geospatial data layers in QGIS	4
3	Raster base vectorization in QGIS	4
4	Overview of database design software	4
5	Installation of software for working with databases.	6
6	Setting up software for working with databases.	6
7	NoSQL database technologies	10
8	Procedural programming languages when working with SQL	3
9	Functions used in SQL databases	4
Total		45

6. Methods of assessing expected learning outcomes:

- oral or written survey;
- test;
- defending laboratory works, projects;
- peer-to-peer assessment, self-assessment.

7. Teaching methods :

- problem-based method;
- practice oriented studying method;
- project education method;
- research based method;
- learning discussions and debates method;
- team work, brainstorm method.

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
SEMANTIC MODULE I. Basics of Geoinformation systems and technologies		
Theme 1. Introduction to Geoinformation science		
Laboratory work 1.	ELO 1, 9	10
Laboratory work 2.	ELO 1, 9, 10	10
Self-study work 1.	ELO 1, 3, 4	5
Theme 2. Model of spatial data: vector and object data models		
Laboratory work 3.	ELO 1, 9, 10	10
Laboratory work 4.	ELO 1, 9, 10	10
Self-study work 2.	ELO 1, 2	5
Theme 3. Model of spatial data. Mosaic models		
Laboratory work 5.	ELO 1, 9, 10	10
Laboratory work 6.	ELO 1, 9, 10, 11	5
Self-study work 3.	ELO 1. 10	5
Module control work 1.		30
Total for module 1		100
SEMANTIC MODULE II. Modern technology of databases, Normalization		
Theme 4. Basic concepts and determination of database theory		
Laboratory work 7.	ELO 1, 10, 11	5
Self-study work 4.	ELO 1, 10	5
Theme 5. Stages of database design		
Laboratory work 8.	ELO 1, 10, 11	5
Self-study work 5.	ELO 1, 10, 11	5
Self-study work 6.	ELO 1, 10, 11	5
Theme 6. Database system concepts and architecture		
Laboratory work 9	ELO 1, 11,13,14	5
Laboratory work 10	ELO 1, 11,13,14	5
Theme 7. Data modeling using the entity-relationship model		

Laboratory work 11	ELO 1, 11,13,14	5
Theme 8. Relational database design		
Laboratory work 12	ELO 1, 11,13,14	5
Laboratory work 13	ELO 1, 11,13,14	5
Self-study work 7	ELO 1, 9	5
Theme 9. Normalization as way to control of database structure. Normal forms 1-3		
Laboratory work 14	ELO 1, 11,13,14, 15	5
Theme 10. Normalization. The heist normal forms		
Laboratory work 15	ELO 1, 4,11,13,14, 15	5
Laboratory work 16	ELO 1,4, 11,13,14, 15	5
Module control work 2.		30
Total for module 2		100
SEMANTIC MODULE IV. Operation with data		
Theme 11. Modern database methodology infological design		
Laboratory work 17	ELO 1, 11,13,14, 15	10
Theme 12. Relational algebra		
Laboratory work 18	ELO 1, 11,13,14, 15	10
Laboratory work 19	ELO 1, 11,13,14, 15	10
Theme 13. Operation and query languages		
Laboratory work 20	ELO 1, 11,13,14, 15	10
Laboratory work 21	ELO 1, 11,13,14, 15	10
Self-study work 8	ELO 1,10	10
Self-study work 9	ELO 1, 10	10
Module control work 2.		30
Total for module 2		100
Class work	(M1 + M2)/2*0.7 ≤ 70	
Credit	30	
Total for year	(Coursework + 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	<i>EXAMPLE:</i> 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	<i>EXAMPLE:</i> 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	<i>EXAMPLE:</i> 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:

electronic educational course of the educational discipline (on the educational portal of NUBiP of Ukraine eLearn - <https://elearn.nubip.edu.ua/course/view.php?id=158>);

- abstracts of lectures and their presentations (in electronic form -

<https://elearn.nubip.edu.ua/course/view.php?id=158>);

- textbooks, training aids, workshops;

- methodical materials on the study of the academic discipline for students of higher education full-time and part-time forms of higher education

- ✓ Moskalenko A.A., Primak L.V., Zayachkivska B.B., Geoinformation systems and databases (methodical instructions for performing laboratory work for students of specialty 193. Geodesy and land management) – К– 2024 – p.188.
- ✓ Москаленко А.А., Примак Л.В., Заячківська Б.Б., Денисюк Б.І. Геоінформаційні системи і бази даних (методичні вказівки до виконання лабораторних робіт для студентів спеціальності 193. Геодезія і землеустрій) – К: Компрінт – 2023 – с.188.
- ✓ Кохан С.С., Москаленко А.А., Іванюта О.О. Geoinformation systems and databases (a series of lectures) для студентів напряму підготовки «Геодезія, картографія та землеустрій» - К.: ЦК «КОМПРИНТ», 2014.
- ✓ Назаренко Н.М., Москаленко А.А. Навчально-методичний посібник «Геоінформаційні системи і бази даних» - Видавничий центр НУБіП, 2010

10. Recommended sources of information

1. Основи створення інтегрованих геопросторових даних. / Ю. О. Карпінський та ін. – Київ: КНУБА, 2023. – 302 с.
2. Основи геоінформаційних систем і бази даних: підручник /О.Є. Поморцева; Харків. нац.ун-т міськ.гос-ва ім. О. М. Бекетова. – Харків, 2022 – 346с.
3. Allen Taylor. SQL For Dummies, 9th edition. 2020 – 544p.
4. Database Systems: A Practical Approach to Design, Implementation, and Management Third Edition / Thomas Connolly, Carolyn Begg. 2014 – 1440 p.
5. Ekmasri, R. and Navatane, S.B. Fundamentals of Database Systems, 7th ed., Addison-Wesley, Reading, Boston, MA, 2017
6. Геоінформаційні системи і бази даних: монографія / В. І. Зацерковний, В. Г. Бурачек, О. О. Железняк, А. О. Терещенко. – Ніжин: НДУ ім. М. Гоголя, 2014. – 492 с.
7. A Moskalenko (2021) GIS support of forming spatial decisions on land use. Mechanization in agriculture & Conserving of the resources 67 (3), 79-81.
8. What is GIS? - <https://www.esri.com/en-us/what-is-gis/overview>
9. Стандарти та специфікації відкритого геопросторового консорціуму OGC, <http://www.opengeospatial.org/standards>
10. Географічна інформація. Еталонна модель: ДСТУ ISO 19101:2009. – [Чинний від 2011-07-01] – К.: Держспоживстандарт України, 2011. – 44 с.
11. Географічна інформація. Сервіси: ДСТУ ISO 19119:2017 (ISO:19119:2016, IDT). – [Чинний від 2017-10-01] – К: ДП «УкрНДНЦ».
12. Географічна інформація. Метадані – XML-схема реалізації: ДСТУ ISO/TS 19139:2017(ISO/TS 19139:2007, IDT). – [Чинний від 2017-10-01] – К: ДП «УкрНДНЦ».
13. Географічна інформація. Мова концептуальних схем: ДСТУ ISO 19103:2017 (ISO 19103:2015, IDT). – [Чинний від 2017-10-01] – К: ДП «УкрНДНЦ».
14. Географічна інформація. Просторова схема: ДСТУ ISO 19107:2017 (ISO 19107:2003, IDT). – [Чинний від 2017-10-01] – К: ДП «УкрНДНЦ».
15. Географічна інформація. Правила для прикладної схеми: ДСТУ ISO 19109:2017 (ISO 19109:2015, IDT). – [Чинний від 2017-10-01] – К: ДП «УкрНДНЦ».

16. Географічна інформація. Просторова прив'язка за географічними ідентифікаторами: ДСТУ ISO 19112:2017 (ISO 19112:2003, IDT) – [Чинний від 2017-10-01]. – Київ: Держспоживстандарт України, 2017.
17. Географічна інформація. Схема для геометрії і функцій покриття: ДСТУ ISO 19123:2017 (ISO 19123:2005, IDT). – [Чинний від 2017-10-01] – К: ДП «УкрНДНЦ».
18. Географічна інформація. Правила моделювання геопросторових даних ДСТУ 8774:2018 – [Чинний від 2019-07-01] – К: ДП «УкрНДНЦ».
19. СОУ 742-33739540 0010:2010 КС БТД Загальні вимоги – Київ: Мінприроди України, 2010.
20. СОУ 742-33739540 0014:2010 КС БТД Вимоги до якості топографічних даних – Київ: Мінприроди України, 2010.
21. ISO 19115-1:2014 Geographic information – Metadata – Part 1: Fundamentals.
22. ISO 19157:2013 Geographic information — Data quality.
23. ISO/IEC 13249-3:2016 Information technology – Database languages – SQL multimedia and application packages – Part 3: Spatial.
24. ISO/IEC 2382:2015 Information technology – Vocabulary.
25. OGC SFA – Simple feature access – Part 1: Common architecture. 2010.
26. OGC SFA-S – Simple feature access – Part 2: SQL option, 2010.
27. Dia [Електронний ресурс]. – Режим доступу: <http://dia-installer.de/>