**NATIONAL UNIVERSITY OF LIFE AND ENVIRONMENTAL SCIENCES OF UKRAINE**
Department of Geoinformatics and Aerospace Research of the Earth

**APPROVED**
Faculty of Land Management

May 14, 2026

# CURRICULUM ACADEMIC DISCIPLINE

## GEOINFORMATION SYSTEMS AND DATABASES

| | |
|---|---|
| Discipline | 19. Architecture and Construction |
| Specialty | 193. Geodesy and land management |
| Educational program | "Geodesy and land management" |
| Faculty | land management |
| Developers: | Antonina MOSKALENKO, head of department, PhD in technical sciences, associate professor |

Kyiv – 2026

**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.

**List of prerequisite academic disciplines:** Mathematical processing and analysis of geodata; Electronic geodetic instruments

***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 | | | |
| | | | l | p | lab | ind | s.w. | | l | p | lab | ind |
| 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 |
| **SEMANTIC MODULE I. Basics of Geoinformation systems and tecnologies** | | | | | | | | | | | | |
| 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

| № | ***Topic*** | 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

| № | ***Topic*** | 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 | Assess-ment |
|---|---|---|
| **SEMANTIC MODULE I. Basics of Geoinformation systems and tecnologies** | | |
| 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*** | *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:

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) – K– 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: Компринт – 2023 – с.188.

## 10. Recommended sources of information


1. Moskalenko, A., & Ievsiukov, T. (2025). Designing a conceptual model of the geospatial database for hazardous animal burial sites affected by anthrax. Scientific and Industrial Journal "Land Management, Cadastre and Land Monitoring", 3, 43-50. https://doi.org/10.31548/zemleustriy2025.03.05

**2.** Москаленко А., Євсюков Т. (2026) ГІС-аналіз і картографічне моделювання просторово-часового поширення сибірки і небезпечних поховань тварин у Вінницькій області. Збірник наукових праць "Сучасні досягнення геодезичної науки та виробництва", 1, 170-180. DOI: **www.doi.org/10.33841/1819-1339-1-51-170-180**

3. Кузьменко І. С., Москаленко А. А., Заячківська Б. Б. (2026) Проєктування бази геопросторових даних для інформаційного забезпечення систем органічного землеробства. Агроекологічний журнал. 2026. № 1. DOI: https://doi.org/10.33730/2077-4893.1.2026.354126.

4. Основи створення інтероперабельних геопросторових даних. / Ю. О. Карпінський та ін. – Київ: КНУБА, 2023. – 302 с.

5. Основи геоінформаційних систем і бази даних: підручник /О.Є. Поморцева; Харків. нац.ун-т міськ.гос-ва ім. О. М. Бекетова. – Харків, 2022 – 346с.

6. Allen Taylor. SQL For Dummies, 9th edition. 2020 – 544p.

7. Database Systems: A Practical Approach to Design, Implementation, and Management Third Edition / Thomas Connolly, Carolyn Begg. 2014 – 1440 p.

8. Ekmasri, R. and Navatane, S.B. Fundamentals of Database Systems, 7th ed., Addison-Wesly, Reading, Boston, MA, 2017

9. 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.

10. A Moskalenko (2021) GIS support of forming spatial decisions on land use. Mechanization in agriculture & Conserving of the resources 67 (3), 79-81.
11. What is GIS? - https://www.esri.com/en-us/what-is-gis/overview
12. Стандарти та специфікації відкритого геопросторового консорціуму OGC, http://www.opengeospatial.org/standards
13. Географічна інформація. Еталонна модель: ДСТУ ISO 19101:2009. – [Чинний від 2011-07-01] – К.: Держспоживстандарт України, 2011. – 44 с.
14. Географічна інформація. Сервіси: ДСТУ ISO 19119:2017 (ISO:19119:2016, IDT). – [Чинний від 2017-10-01] – К: ДП «УкрНДНЦ».
15. Географічна інформація. Метадані – XML-схема реалізації: ДСТУ ISO/TS 19139:2017(ISO/TS 19139:2007, IDT). – [Чинний від 2017-10-01] – К: ДП «УкрНДНЦ».
16. Географічна інформація. Мова концептуальних схем: ДСТУ ISO 19103:2017 (ISO 19103:2015, IDT). – [Чинний від 2017-10-01] – К: ДП «УкрНДНЦ».
17. Географічна інформація. Просторова схема: ДСТУ ISO 19107:2017 (ISO 19107:2003, IDT). – [Чинний від 2017-10-01] – К: ДП «УкрНДНЦ».
18. Географічна інформація. Правила для прикладної схеми: ДСТУ ISO 19109:2017 (ISO 19109:2015, IDT). – [Чинний від 2017-10-01] – К: ДП «УкрНДНЦ».
19. 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.
20. Географічна інформація. Схема для геометрії і функцій покриття: ДСТУ ISO 19123:2017 (ISO 19123:2005, IDT). – [Чинний від 2017-10-01] – К: ДП «УкрНДНЦ».
21. Географічна інформація. Правила моделювання геопросторових даних ДСТУ 8774:2018 – [Чинний від 2019-07-01] – К: ДП «УкрНДНЦ».
22. СОУ 742-33739540 0010:2010 КС БТД Загальні вимоги – Київ: Мінприроди України, 2010.
23. СОУ 742-33739540 0014:2010 КС БТД Вимоги до якості топографічних даних – Київ: Мінприроди України, 2010.
24. ISO 19115-1:2014 Geographic information – Metadata – Part 1: Fundamentals.
25. ISO 19157:2013 Geographic information — Data quality.
26. ISO/IEC 13249-3:2016 Information technology – Database languages – SQL multimedia and application packages – Part 3: Spatial.
27. ISO/IEC 2382:2015 Information technology – Vocabulary.
28. OGC SFA – Simple feature access – Part 1: Common architecture. 2010.
29. OGC SFA-S – Simple feature access – Part 2: SQL option, 2010.
30. Dia [Електронний ресурс]. – Режим доступу: http://dia-installer.de/