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**Federal State Autonomous Educational Institution of Higher Education
Peoples' Friendship University of Russia named after Patrice Lumumba**

Academy of Engineering

(name of the main educational unit (MEU) that developed the educational program of higher education)

WORKING PROGRAM OF THE DISCIPLINE

ANALYSIS OF GEOINFORMATION DATA

(name of discipline/module)

Recommended for the field of study/specialty:

27.03.04 CONTROL IN TECHNICAL SYSTEMS

(code and name of the field of study/specialty)

The discipline is mastered within the framework of the implementation of the main professional educational program of higher education (EP HE):

DATA SCIENCE AND SPACE SYSTEMS

(name (profile/specialization) of the educational institution of higher education)

1. THE GOAL OF MASTERING THE DISCIPLINE

The course "Analysis of Geoinformation Data" is part of the bachelor's program "Data Science and Space Systems" in the 27.03.04 "Control in Technical Systems" program and is studied in semesters 4, 5, and 6 of years 2 and 3. The course is offered by the Department of Mechanics and Control Processes. It consists of two sections and seven topics and focuses on the principles of GIS operation, spatial analysis methods (vector, raster, and network), geodatabase creation and management technologies, and practical application of GIS in applied fields.

The purpose of mastering this course is to develop students' systematic theoretical knowledge and practical competencies in the field of geographic information systems, spatial analysis methods, and geodata processing technologies necessary for solving applied professional problems in various sectors of the economy and territorial management.

2. REQUIREMENTS FOR THE RESULTS OF MASTERING THE DISCIPLINE

Mastering the discipline "Analysis of geoinformation data" aimed at developing the following competencies (parts of competencies) in students:

Table 2.1. List of competencies developed in students while mastering the discipline (results of mastering the discipline)

Cipher	Competence	Indicators of Competency Achievement (within this discipline)
UC-12	Able to search for relevant sources of information and data, perceive, analyze, memorize, and transmit information using digital tools, as well as algorithms when working with data obtained from various sources in order to effectively use the information obtained to solve problems; evaluate information, its reliability, and draw logical conclusions based on incoming information and data	UC-12.1 Searches for the necessary sources of information and data, perceives, analyzes, remembers and transmits information using digital means, as well as with the help of algorithms when working with data obtained from various sources in order to effectively use the information received to solve problems; UC-12.2 Conducts an assessment of information, its reliability, builds logical conclusions based on incoming information and data;
GPC-2	Able to formulate objectives for professional activity based on knowledge of specialized sections of mathematical and natural science disciplines (modules)	GPC-2.1 Has a command of mathematical methods, programming fundamentals and specialized programming systems for implementing algorithms for solving applied problems; GPC-2.2 Able to select and adapt mathematical methods and software to solve practical problems; GPC-2.3 Possesses skills in developing and implementing algorithms for solving applied problems in the field of professional activity;
GPC-3	Able to use fundamental knowledge to solve basic control problems in technical systems in order to improve in professional activities	GPC-3.1 Knows the theoretical foundations and principles of mathematical modeling; GPC-3.2 Able to develop and use methods of mathematical modeling, information technologies to solve problems of applied mathematics; GPC-3.3 Possesses practical skills in solving problems of applied mathematics, methods of mathematical modeling, information technologies and the basics of their use in professional activities, skills of professional thinking and an arsenal of methods and approaches necessary for the adequate use of methods of modern mathematics in theoretical and applied problems;
GPC-4	Capable of evaluating the effectiveness of management systems developed using mathe-	GPC-4.1 Knows the basic requirements of information security, existing information communication technologies; GPC-4.2 Able to solve professional tasks using information and

Cipher	Competence	Indicators of Competency Achievement (within this discipline)
	mathematical methods	communication technologies and taking into account the basic requirements of information security; GPC-4.3 Possesses the skills to use existing information technologies to solve problems of professional activity;
GPC-5	Capable of solving problems of development of science, engineering and technology in the field of management in technical systems, taking into account the legal framework in the field of intellectual property	GPC-5.1 Knows the theoretical foundations of digital technologies, the basics of modeling objects of professional activity, the basics of data analysis and presentation of information; GPC-5.2 Able to solve problems of professional activity using existing methods of modeling, data analysis, and information presentation; GPC-5.3 Possesses skills in developing algorithms and computer programs suitable for practical application;
GPC-9	Able to perform experiments using given methods and process the results using modern information technologies and technical means	GPC-9.1 Knows modern information technologies and technical means; GPC-9.2 Able to apply modern information technologies and technical means to process experimental results; GPC-9.3 Proficient in modern information technologies and technical means for performing experiments and processing results;
PC-1	Capable of collecting, processing and interpreting modern scientific research data necessary to draw conclusions on relevant scientific research, including Earth remote sensing data	PC-1.1 Knows modern methods of collecting, processing and interpreting data from modern scientific research necessary for drawing conclusions on relevant scientific research; PC-1.2 Able to apply modern methods and tools for processing and interpreting scientific research data; PC-1.3 Possesses the basic skills of collecting, processing and interpreting data from modern scientific research, necessary for drawing conclusions on relevant scientific research;
PC-3	Capable of carrying out work on processing and analyzing information in the field of application of mathematical methods and information technologies in the field of application of remote sensing data of the Earth from space	PC-3.1 Knows the basic concepts in the field of application of mathematical methods and information technologies and application of remote sensing space systems; PC-3.2 Able to solve analytical problems that offer a choice from a variety of relevant problem-solving methods, has skills in working with geographic information systems software packages; PC-3.3 Possesses practical skills in solving problems related to obtaining, processing and applying remote sensing data of the Earth from space;
PC-5	Able to develop, debug, test performance, and modify software; apply software design methods and tools, develop and coordinate software documentation	PC-5.1 Knowledge of existing system and application software, software design and development methods, database structures and structures, and software interfaces. Knowledge of regulatory and technical documentation for the development of software documentation; PC-5.2: Able to apply methods and tools for designing software, data structures, databases, and programming interfaces. Able to analyze regulatory and technical documentation for the development of software documentation; PC-5.3 Possesses basic skills in technologies for development, debugging, performance testing and modification of system application software, and modernization of technical solutions for software development;

3. PLACE OF THE DISCIPLINE IN THE STRUCTURE OF THE EDUCATIONAL INSTITUTION

Discipline "Analysis of geoinformation data" refers to the mandatory part of block 1 "Disciplines (modules)" of the educational program of higher education.

As part of the higher education program, students also master other disciplines and/or practices that contribute to the achievement of the planned results of mastering the discipline "Analysis of geoinformation data".

Table 3.1. List of components of the educational program of higher education that contribute to the achievement of the planned results of mastering the discipline

Cipher	Name of competence	Previous courses/modules, practical training*	Subsequent disciplines/modules, practices*
UC-12	Able to search for relevant sources of information and data, perceive, analyze, memorize, and transmit information using digital tools, as well as algorithms when working with data obtained from various sources in order to effectively use the information obtained to solve problems; evaluate information, its reliability, and draw logical conclusions based on incoming information and data	<i>Fundamentals of Information Security and Cyber Resilience**</i> ; <i>Fundamentals of Information Security and Cyber Resilience**</i> ;	Technological Training; Undergraduate Training; Research Work; Optimal Control Methods;
GPC-2	Able to formulate objectives for professional activity based on knowledge of specialized sections of mathematical and natural science disciplines (modules)	<i>Mathematical analysis</i> ; <i>Space Flight Mechanics</i> ; <i>Algebra and Geometry</i> ;	Space Flight Mechanics; Equations of mathematical physics; Technological Training; Undergraduate Training; Research Work;
GPC-3	Able to use fundamental knowledge to solve basic control problems in technical systems in order to improve in professional activities	<i>Mathematical analysis</i> ; <i>Space Flight Mechanics</i> ; <i>Theoretical Mechanics</i> ; <i>Algebra and Geometry</i> ; <i>Theory of Probability and Mathematical Statistics</i> ; <i>Differential equations</i> ;	Space Flight Mechanics; Equations of mathematical physics; Optimal Control Methods; Technological Training; Undergraduate Training;
GPC-4	Capable of evaluating the effectiveness of management systems developed using mathematical methods	<i>Differential equations</i> ;	Technological Training; Undergraduate Training;
GPC-5	Capable of solving problems of development of science, engineering and technology in the field of management in technical systems, taking into account the legal framework in the field of intellectual property	<i>Theoretical Mechanics</i> ;	Technological Training; Undergraduate Training;
GPC-9	Able to perform experiments using given methods and process the results using modern information technologies and technical means	<i>Computer Science and Programming</i> ; <i>Basic Military Training. Life Safety</i> ;	Undergraduate Training; Technological Training; Optimal Control Methods;
PC-1	Capable of collecting, processing and interpreting modern scientific research data necessary to draw conclusions on relevant scientific research, including Earth remote sensing data	<i>Space Flight Mechanics</i> ; <i>Computer Science and Programming</i> ; <i>Discrete Mathematics**</i> ; <i>Discrete Mathematics**</i> ;	Space Flight Mechanics; <i>Virtual and Augmented Reality Technology**</i> ; <i>Virtual and augmented reality technologies**</i> ; Optimal Control Methods; Technological Training;

Cipher	Name of competence	Previous courses/modules, practical training*	Subsequent disciplines/modules, practices*
			Undergraduate Training;
PC-3	Capable of carrying out work on processing and analyzing information in the field of application of mathematical methods and information technologies in the field of application of remote sensing data of the Earth from space		Technological Training; Undergraduate Training;
PC-5	Able to develop, debug, test performance, and modify software; apply software design methods and tools, develop and coordinate software documentation	<i>Fundamentals of Information Security and Cyber Resilience**;</i> <i>Fundamentals of Information Security and Cyber Resilience**;</i>	Technological Training; Undergraduate Training; Research Work; <i>Virtual and Augmented Reality Technology**;</i> <i>Virtual and augmented reality technologies**;</i>

* - filled in accordance with the competency matrix and the SUP EP HE

** - elective courses/practices

4. SCOPE OF THE DISCIPLINE AND TYPES OF EDUCATIONAL WORK

The total workload of the course “Analysis of geoinformation data” is 13 credit units.

Table 4.1. Types of educational work by periods of mastering the educational program of higher education for full-time education.

Type of academic work	TOTAL,academic hours		Semester(s)		
			4	5	6
<i>Contact work, academic hours</i>	142		34	54	54
Lectures (LC)	53		17	18	18
Laboratory work (LW)	89		17	36	36
Practical/seminar classes (SC)	0		0	0	0
<i>Independent work of students, academic hours</i>	236		38	63	135
<i>Control (exam/test with assessment), academic hours</i>	90		36	27	27
Total complexity of the discipline	academic hours	468	108	144	216
	credit	13	3	4	6

5. CONTENT OF THE DISCIPLINE

Table 5.1. Content of the discipline (module) by types of academic work

Section number	Name of the discipline section	Topic Title		Topic Contents	Type of academic work*
Section 1	Theoretical foundations and technologies of geographic information systems	1.1	Introduction to GIS: Basic Concepts and Structure	Definition of GIS and its development history. Classification of GIS (by territorial coverage, functionality, and problem-oriented approach). GIS components: hardware, software, data, methods, and specialists. Areas of GIS application (ecology, urban planning, transportation, agriculture, oil and gas, and the Ministry of Emergency Situations).	LC, LW
		1.2	Spatial data and data models	Understanding spatial and attribute data. Methods of organizing spatial data: raster model (pixel, resolution, zones) and vector model (point, line, polygon). Their advantages and disadvantages. Topological data models. Geodata storage formats (Shapefile, GeoPackage, File Geodatabase, raster formats).	LC, LW
		1.3	Coordinate systems and map projections	The concept of a geodetic datum. Geographic coordinate systems (latitude/longitude) and rectangular (projected) coordinates. Cartographic projections: classification by the nature of distortion (conformal, equal-area, arbitrary). Coordinate systems used in the Russian Federation: SC-90, WGS-84, MSK (local coordinate systems). Data reprojection.	LC, LW
		1.4	Spatial Analysis: Basic Operations	Understanding spatial queries. Selecting objects by attributes and by location (Select by Attributes, Select by Location). Spatial joins (Spatial Join). Vector analysis: buffering, overlay (Intersect, Union, Erase, Clip). Raster analysis: reclassification, map algebra, raster calculator.	LC, LW
Section 2	Applied application of GIS and solving industry problems	2.1	Digital terrain modeling and 3D analysis	Terrain data sources: SRTM, ASTER GDEM, ALOS PALSAR, lidar data. Digital elevation model (DEM) and digital terrain model (DTM) generation. Derived morphometric map creation: slope, aspect, horizontal and vertical curvature. Hydrological modeling: drainage basin identification, thalweg construction. 3D scene and profile generation.	LC, LW
		2.2	GIS in ecology and nature management	Assessment of anthropogenic impact on the territory. Monitoring vegetation condition using vegetation indices (NDVI, SAVI). Mapping of disturbed lands. Analysis of pollution spread (modeling of buffer zones for industrial facilities). Ecological zoning of the territory. Maintenance of cadastres of specially protected nat-	LC, LW

Section number	Name of the discipline section	Topic Title	Topic Contents	Type of academic work*
			ural areas (SPNA).	
		2.3 Design and presentation of GIS analysis results. Map creation	Cartographic design principles. Map layout creation: adding layers, scale bar, legend, north arrow, and output data (title, date, source). Map export to raster and vector formats (JPG, PNG, PDF, SVG). Creating interactive web maps (QGIS). Preparing analytical reports with cartographic data.	LC, LW

* - to be completed only for FULL-TIME education: LC – lectures; LW – laboratory work; SC – practical/seminar classes.

6. LOGISTIC AND TECHNICAL SUPPORT OF DISCIPLINE

Table 6.1. Material and technical support for the discipline

Audience type	Equipment of the auditorium	Specialized educational/laboratory equipment, software and materials for mastering the discipline (if necessary)
Lecture	A lecture hall equipped with specialized furniture, a whiteboard (screen), and multimedia presentation equipment.	
Computer class	A computer room for conducting classes, group and individual consultations, ongoing monitoring and midterm assessment, equipped with personal computers (14 in total), a board (screen) and technical means for multimedia presentations.	Computer class
For independent work	A classroom for independent student work (can be used for seminars and consultations), equipped with a set of specialized furniture and computers with access to the Electronic Information System.	Computer class
Lecture	A lecture hall equipped with specialized furniture, a whiteboard (screen), and multimedia presentation equipment.	Projector

* - the classroom for independent work of students MUST be indicated!

7. EDUCATIONAL, METHODOLOGICAL AND INFORMATIONAL SUPPORT OF THE DISCIPLINE

Main literature:

1. Zolnikov, I. D. Introduction to geoinformation systems and remote sensing: a textbook for universities / I. D. Zolnikov, N. V. Glushkova. - Moscow: Yurait Publishing House, 2025. - 118 p. - (Higher education). - ISBN 978-5-534-18577-5.

2. Berdenov, Zh. G. Application of geographic information systems in modern geographical science: a tutorial. - Almaty: ESPI, 2023. - 264 p. - ISBN 978-601-327-887-2.

3. Tolstov, E. G. GIS in cadastral activities: a tutorial / E. G. Tolstov, N. V. Kanashin, O. M. Mater, V. E. Bozhbov. - St. Petersburg: SPbGLTU, 2023. - 136 p.

Further reading:

1. Kurakina, N. I. Organization and geoanalysis of digital data: a tutorial / N. I. Kurakina, N. V. Orlova. - St. Petersburg: Publishing house of ETU "LETI", 2024. - 53 p. - ISBN 978-5-7629-3418-3.

2. Karimi, H. A. Big Data: Techniques and Technologies in Geoinformatics / edited by H. A. Karimi. — 2nd ed. - CRC Press, 2025. - 385 p. — ISBN 9781032919539.

3. de Lange, N. Geoinformatics in Theory and Practice: An Integrated Approach to Geoinformation Systems, Remote Sensing and Digital Image Processing. — Springer, 2025.

4. Remote Sensing, GIS and GPS: Principles and Applications. — Zenodo, 2025. — 15.9 MB.

Resources of the information and telecommunications network "Internet":

1. RUDN University Electronic Library System and third-party electronic library systems

to which university students have access based on concluded agreements

- RUDN University Electronic Library System – RUDN University Electronic Library System <https://mega.rudn.ru/MegaPro/Web>
- Electronic Library System "University Library Online" <http://www.biblioclub.ru>
- EBS "Urayt" <http://www.biblio-online.ru>
- Electronic Library System "Student Consultant" www.studentlibrary.ru
- EBS "Knowledge" <https://znanium.ru/>

2. Databases and search engines

- Sage <https://journals.sagepub.com/>
- Springer Nature Link <https://link.springer.com/>
- Wiley Journal Database <https://onlinelibrary.wiley.com/>
- Scientometric database Lens.org <https://www.lens.org>

Educational and methodological materials for independent work of students in mastering a discipline/module:*

1. Lecture course on the subject "Analysis of geoinformation data".

* - all teaching and methodological materials for independent work of students are posted in accordance with the current procedure on the discipline page in TUIS!

DEVELOPER:

Senior Lecturer

Position, DEPARTMENT

Signature

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Mikhailovna

Surname I.O.

HEAD OF THE DEPARTMENT:

Head of Department

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