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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

INTRODUCTION TO GEOSPATIAL TECHNOLOGY

(name of discipline/module)

Recommended for the field of study/specialty:

27.04.04 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):

Artificial Intelligence, Machine Learning, and Space Science

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

1. THE GOAL OF MASTERING THE DISCIPLINE

The course "Introduction to Geospatial Technology" is part of the Master's program "Artificial Intelligence, Machine Learning, and Space Sciences" (major 27.04.04 "Control in Technical Systems") and is studied in the first semester of the first year. The course is offered by the department of the partner university. It consists of three sections and three topics and focuses on the principles of creating and operating geographic information systems and mastering the principles of spatial data analysis.

The purpose of mastering the discipline is to provide students with knowledge of geographic information systems and technologies, and to develop skills in spatial analysis of geodata.

2. REQUIREMENTS FOR THE RESULTS OF MASTERING THE DISCIPLINE

Mastering the course "Introduction to Geospatial Technologies" 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)
GPC-1	Able to analyze and identify the natural scientific essence of control problems in technical systems based on provisions, laws and methods in the field of natural sciences and mathematics	GPC-1.3 Proficient in tools for analyzing control problems in technical systems;
GPC-9	Capable of developing methods and performing experiments at existing facilities with processing of results based on information technology and technical means	GPC-9.1 Possesses modern information technologies and technical means for conducting experiments at operating facilities; GPC-9.2 Has skills in developing methods and conducting experiments at existing facilities; GPC-9.3 Has the skills to develop methods and conduct experiments at existing facilities with processing of results using information technology;
PC-3	Capable of carrying out work and research on the processing and analysis of scientific and technical information obtained using geographic information systems and technologies	PC-3.1 Able to analyze the results of theoretical and experimental research; PC-3.2 Able to formulate recommendations for improving devices and systems, prepare scientific research results for publication and prepare documents for filing an invention application; PC-3.3 Participates in the analysis of research results, has the skills to formulate recommendations for improving devices and systems, as well as write articles and submit documents for registration of inventions;

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

Course "Introduction to Geospatial Technologies" 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 "Introduction to Geospatial Technologies".

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*
GPC-1	Able to analyze and identify the natural scientific essence of control problems in technical systems based on provisions, laws and methods in the field of natural sciences and mathematics		Undergraduate practice / Pre-graduation practice; Geoinformation Systems and Applications;
GPC-9	Capable of developing methods and performing experiments at existing facilities with processing of results based on information technology and technical means		Undergraduate practice / Pre-graduation practice; Dynamics and Control of Space Systems; Geoinformation Systems and Applications; Advance Python Programming for Spatial Analytics; Operations Research and Optimization Techniques;
PC-3	Capable of carrying out work and research on the processing and analysis of scientific and technical information obtained using geographic information systems and technologies		Research work / Scientific research work (acquiring primary skills in scientific research work); Undergraduate practice / Pre-graduation practice; Advance Python Programming for Spatial Analytics;

* - 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 "Introduction to Geospatial Technologies" is 4 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)
			1
<i>Contact work, academic hours</i>	34		34
Lectures (LC)	17		17
Laboratory work (LW)	17		17
Practical/seminar classes (SC)	0		0
<i>Independent work of students, academic hours</i>	83		83
<i>Control (exam/test with assessment), academic hours</i>	27		27
Total complexity of the discipline	academic hours	144	144
	credit	4	4

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	General information about geographic information systems	1.1	Definition of the terms "information" and "information system." Classification of information and information systems. Geographic information systems. Stages of GIS development. Relationship of GIS with other sciences. Aspects of GIS. Subject, functions, tasks, and goals of GIS development. Components and structure of GIS. Classifications of GIS. Concept of an object and its properties. Spatial objects and their properties. Geospatial data and their structure. Data organization in GIS.	Definition of the concepts "information" and "information system." Classification of information by presentation form, method of perception, and area of origin. Classification of information systems by scale, scope, and organization. Definition of a geographic information system (GIS). Stages of GIS development: from the first cartographic systems to modern cloud solutions. Interdisciplinary connections of GIS: geography, cartography, computer science, remote sensing, mathematics. Aspects of GIS: technological, applied, organizational. The subject, functions, tasks, and goals of geoinformatics.	LC, LW
Section 2	Data models in GIS	2.1	Spatial data models. Raster data models. Raster data compression methods. Vector method for representing geographic space. Vector data models. Compression of vector data models. The concept of "database" and "data model". Classification of data models. Basic concepts of a relational database. Database management systems.	Raster data models: principles of organization, cells (pixels), spatial resolution. Methods of representing spatial objects in raster format. Raster data compression methods: run-length coding, chain coding, quadtrees. Advantages and limitations of raster models. Vector method of representing geographic space: points, lines, polygons. Vector data models: topological (arc-node) and non-topological (spaghetti). Methods of compression of vector data models. The concept of a database (DB) and database models. Organization of spatial and attribute data.	LC, LW
Section 3	GIS functionality	3.1	GIS functionality. Data entry functions. Data transformation functions. Projection transformation functions. Data model transformation functions. Database functions. Queries. Cartometric operations functions. Spatial analysis and modeling functions. Operations data output and visualization. Non-standard data visualization methods. The concept of CAD, history of creation, structure, classification, examples of CAD.	Functional capabilities of modern geographic information systems. Data input functions: digitization, scanning, import from external sources, GPS measurements, remote sensing. Data conversion functions: format changes, resolution adjustments, coordinate recalculation. Projection transformation functions: conversion between coordinate systems and map projections, reprojection of spatial data, ensuring metric consistency. Visualization, spatial analysis, and output of results.	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 (in the amount of ____ units), a board (screen) and technical means for multimedia presentations.	
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.	

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

7. EDUCATIONAL, METHODOLOGICAL AND INFORMATIONAL SUPPORT OF THE DISCIPLINE

Main literature:

1. Abdalla R. Introduction to geospatial information and communication technology (GeoICT). – Cham, Switzerland: Springer International Publishing, 2016.
2. Haklay MM (ed.). Interacting with geospatial technologies. – John Wiley & Sons, 2010.

Further reading:

1. Ota M., Plews R. Development of a software tool as an introduction to Geospatial Information Technology based on geospatial standards //Cartography and Geographic Information Science. – 2015. –T. 42. – No. 5. – pp. 419-434.
2. Shit PC et al. (ed.). Geospatial Practices in Natural Resources Management. – Springer, 2024.

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 Yurayt <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 "Introduction to Geospatial Technologies".

* - 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:

Associate Professor

Position, DEPARTMENT

Signature

Saltykova Olga
Alexandrovna

Surname I.O.

HEAD OF THE DEPARTMENT:

Position of the DEPARTMENT

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Professor

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