

Документ подписан простой электронной подписью
Информация о владельце:
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Должность: Ректор
Дата подписания: 27.06.2025 11:53:16
Уникальный программный ключ:
ca953a0120d891083f939673078ef1a989dae18a

**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 by MSSN for the training area/specialty:

27.03.04 CONTROL IN TECHNICAL SYSTEMS

(code and name of the training area/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 direction 27.03.04 "Control in Technical Systems" and is studied in semesters 4, 5, 6 of the 2nd and 3rd years. The discipline is implemented by the Department of Mechanics and Control Processes. The discipline consists of 2 sections and 9 topics and is aimed at studying the formation and development of professional, methodological, information and communication competence in accordance with the requirements of the State Educational Standards of the new generation, the formation of special professional competencies related to the possibility of using innovative methods of information support for Control processes in solving applied problems, the maximum approximation of the latest achievements of Russian science to the needs of the educational process, mastering the methodology of project activities taking into account the use of digital educational resources, ensuring a new quality of education using the latest software that allows using the achievements of the RKD, familiarization with international law regulating issues of space activities and the use of space technology; with the general structure and main elements of the international space law system, familiarization with the role of national governments and international organizations in regulating space activities and the use of space technology.

The purpose of mastering the discipline is to form a new quality of education using the latest software that allows using the achievements of the results of space activities (RKD), the formation of special professional competencies related to the possibility of using innovative Control methods in solving problems of international relations. Formation of knowledge about modern remote sensing technologies and the areas of their application for thematic geographical research at different scale levels. Acquisition of practical skills in collecting, automated processing and thematic interpretation of remote sensing data of various types for geographical research.

2. REQUIREMENTS TO THE RESULTS OF MASTERING THE DISCIPLINE

Mastering the discipline "Analysis of geoinformation data" is 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 Competence Achievement (within the framework of this discipline)
UC-12	Able to search for the necessary sources of information and data, perceive, analyze, remember and transmit information using digital means, as well as using algorithms when working with data obtained from various sources in order to effectively use the information received to solve problems; evaluate information, its reliability, build 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 using algorithms when working with data obtained from various sources in order to effectively use the information obtained 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 tasks of professional activity based on knowledge, specialized sections of mathematical and natural science disciplines (modules)	GPC-2.1 Has mastered 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;

Cipher	Competence	Indicators of Competence Achievement (within the framework of this discipline)
		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 assessing the effectiveness of Control systems developed on the basis of mathematical methods	GPC-4.1 Knows the basic requirements of information security, existing information and communication technologies; GPC-4.2 Able to solve professional tasks using information and 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 Control in technical systems, taking into account legal regulation 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	Capable of performing experiments according to specified methods and processing 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 Possesses 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 methods for solving problems, 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, modify software; apply software design methods and tools, develop and coordinate software documentation	PC-5.1 Knows existing system and application software, methods of designing and developing software, structures and databases, software interfaces. Knows regulatory and technical documentation for developing software documentation; PC-5.2 Can apply methods and tools for designing software, data structures, databases, and software interfaces. Can analyze

Cipher	Competence	Indicators of Competence Achievement (within the framework of this discipline)
		regulatory and technical documentation for developing software documentation; PC-5.3 Possesses basic skills in technologies for development, debugging, testing the functionality and modification of system application software, and upgrading technical solutions for software development;

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

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, practices*	Subsequent disciplines/modules, practices*
UC-12	Able to search for the necessary sources of information and data, perceive, analyze, remember and transmit information using digital means, as well as using algorithms when working with data obtained from various sources in order to effectively use the information received to solve problems; evaluate information, its reliability, build 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 tasks of professional activity based on knowledge, specialized sections of mathematical and natural science disciplines (modules)	<i>Mathematical analysis;</i> <i>Space Flight Mechanics;</i> <i>Algebra and Geometry;</i>	Technological Training; Undergraduate Training; Research Work; Space Flight Mechanics; Equations of mathematical physics;
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 assessing the effectiveness of Control systems developed on the	<i>Differential equations;</i>	Technological Training; Undergraduate Training;

Cipher	Name of competence	Previous courses/modules, practices*	Subsequent disciplines/modules, practices*
	basis of mathematical methods		
GPC-5	Capable of solving problems of development of science, engineering and technology in the field of Control in technical systems, taking into account legal regulation in the field of intellectual property	<i>Theoretical Mechanics;</i>	Technological Training; Undergraduate Training;
GPC-9	Capable of performing experiments according to specified methods and processing 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>	Technological Training; Undergraduate Training; Space Flight Mechanics; <i>Virtual and Augmented Reality Technology**;</i> <i>Virtual and augmented reality technologies**;</i> Optimal Control Methods;
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, 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 in accordance with the competency matrix and the SUP EP HE

** - elective disciplines/practices

4. SCOPE OF THE DISCIPLINE AND TYPES OF STUDY WORK

The total workload of the “Analysis of Geoinformation Data” discipline 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,ac.h.		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
General complexity of the discipline	ac.h.	468	108	144	216
	credit.ed.	13	3	4	6

5. CONTENT OF THE DISCIPLINE

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

Section number	Name of the discipline section	Section Contents (Topics)		Type of academic work*
Section 1	Fundamental concepts of geoinformatics	1.1	Basic concepts and definitions: cartography, geoinformatics, GIS, remote sensing.	LC, LW
		1.2	The main tasks of geoinformatics	LC, LW
		1.3	Software and hardware for modern geographic information systems	LC, LW
Section 2	Spatial data	2.1	An overview of various sources of spatial data.	LC, LW
		2.2	Types and sources of spatial data	LC, LW
		2.3	Concept of vector and raster data. Basic data formats	LC, LW
		2.4	The concept of layered data organization	LC, LW
		2.5	Operations with raster and vector data	LC, LW
		2.6	Spatial data visualization	LC, LW

* - filled in 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 of the discipline

Audience type	Equipping the auditorium	Specialized educational/laboratory equipment, software and materials for mastering the discipline (if necessary)
Lecture	An auditorium for conducting lecture-type classes, equipped with a set of specialized furniture; a board (screen) and technical means for multimedia presentations.	
Computer class	A computer room for conducting classes, group and individual consultations, ongoing monitoring and midterm assessment, equipped with personal computers (15 units), a board (screen) and technical means for multimedia presentations.	
For independent work	A classroom for independent work of students (can be used for conducting seminars and consultations), equipped with a set of specialized furniture and computers with access to the Electronic Information System.	

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

7. EDUCATIONAL, METHODOLOGICAL AND INFORMATIONAL SUPPORT OF THE DISCIPLINE

Main literature:

1. Schowengerdt Robert A. Remote Sensing. Models and Methods of Image Processing / Schowengerdt R.A.; Kiryushin A.V., Dem'yanikov A.I. (translated from English). - 3rd ed. - Moscow: Tekhnosfera, 2013. - 589 p.

2. Monograph "Status and Prospects of Using the Results of Space Activities in the Interests of Modernizing the Economy of the Russian Federation and the Development of Its Regions" / Makarov Yu.N., Bezborodov V.G., Zhiganov A.N. et al.; edited by V.G. Bezborodov. – Moscow: ZAO Research Institute ENTSITECH, 2014. – 318 p.

3. Geoinformatics. // Kapralov E.G., Koshkarev A.V., Tikunov V.S., Lurye I.K., Serapinas B.B., Rylsky I.A.; edited by Tikunov V.S. – 3rd ed., revised. and enlarged. – M. Academy, 2010. ISBN: 5-7695-6468-7 ISBN 978-5-7695-6468-0, 400 pp.

4. Fig. U. G. Fundamentals of remote sensing/U. Fig. - Moscow: Tekhnosfera, 2006, ISBN 5-94836-094-6.-336.

5. Tokareva O.S. Processing and interpretation of Earth remote sensing data. Study guide. Publishing house of Tomsk Polytechnic University. Tomsk, 2010 - 148 p.

6. Malin A.S. Regional Control. Study guide State University Higher School of Economics Moscow: GUVShE publishing house, 2006

Further reading:

1. Geoinformatics: in 2 books: textbook for students of higher educational institutions / Kapralov E.G., Koshkarev A.V., Tikunov V.S. et al.; edited by Tikunov V.S. – 2nd ed., revised and enlarged. – M. Academy, 2008, 384 p.

2. Tikunov V.S., Kapralov E.G., Koshkarev A.V., et al. Fundamentals of Geoinformatics. Textbook for Universities. M. Academy. 2004, 2006.

3. Geoinformation mapping. Methods of geoinformatics and digital processing of space images: textbook. // Lurye I.K. - 2nd edition, corrected - M.: KDU, 2010.

4. Mirtova I.A., Topographic interpretation of objects of the Land and City Cadastre. Textbook - M.: Publishing house MIIGAiK, 2007 - 120 p.

5. Handbook of standard and commonly used (common) terms on geodesy and cartography, topography, geoinformation systems, spatial data// Aleksandrov V.N., Bazina M.A., Zhurkin I.G., Kornilova L.V., Pleshkov V.G., Pobedinsky G.G., Rebriy A.V., Timkina O.V. - M. Bratishka, 2007 -736 p.

6. Zhurkin I.G., Shaitura S.V. Geoinformation systems. Kudits-Press, 2009– 272 p.

7. Gruzinov V.S. Systematic foundations of geoinformation modeling of territories // Geodesy and cartography. - 2009. - No. 1 - pp. 51-54

8. Gruzinov V.S. Knowledge system as an element of information support of GIS // News of universities. Geodesy and aerial photography. - 2009. - No. 3 - p. 72-75

9. Gruzinov V.S. Prospects for the development of functional capabilities of GIS software // News of universities. Geodesy and aerial photography. - 2009. No. 6 - p.89-91

10. Gruzinov V.S. Geoportals and geonetworks as elements of the infrastructure for the exchange of geospatial data // News of higher educational institutions. Geodesy and aerial photography, No. 1, 2014 p. 95-100

11. Zhurkin I.G., Chaban L.N., Gruzinov V.S. Geoinformation modeling and mapping of natural resource potential. "Geodesy and Cartography", No. 7, 2009 p. 34-39

12. Kravchenko Yu.A. Fundamentals of designing geomodeling systems. Book 2. Information Geomodeling. Models and Methods. SGGA, Novosibirsk, 2008

Resources of the information and telecommunications network "Internet":

1. RUDN University EBS and third-party EBSs to which university students have access on the basis of concluded agreements

- Electronic library system of RUDN - ELS

RUDN <http://lib.rudn.ru/MegaPro/Web>

- Electronic library system "University library online" <http://www.biblioclub.ru>

- EBS Yurait <http://www.biblio-online.ru>

- Electronic Library System "Student Consultant" www.studentlibrary.ru

- Electronic library system "Troitsky Bridge"

- PC "Quantum GIS (QGIS)"; <http://qgis.org/ru/site/>

- PC "MapInfo"; <http://www.esti-map.ru>

- PC "AutoCAD Map3D"
<http://www.autodesk.ru/adsk/servlet/index?siteID=871736&id=12392051>
 - SAS. Planet; www.sasgis.ru
 - PC "ScanEx Image Processor";
<http://www.scanex.ru/ru/software/default.asp?submenu=imageprocessor&id=basicconfig>
 - JOSM; <http://josm.ru/>
 - 2. Databases and search engines
 - electronic fund of legal and normative-technical documentation <http://docs.cntd.ru/>
 - Yandex search engine <https://www.yandex.ru/>
 - search engine Google <https://www.google.ru/>
 - abstract database SCOPUS <http://www.elsevierscience.ru/products/scopus/>
 - Interregional public organization for promoting the development of the market of geoinformation technologies and services GIS Association website: <http://www.gisa.ru>
 - Association of developers, manufacturers and consumers of equipment and applications based on global navigation satellite systems "GLONASS/GNSS-Forum": <http://aggf.ru/>
 - Inter-industry journal of navigation technologies "Vestnik GLONASS": <http://vestnik-glonass.ru/>
 - The state and prospects of the Russian satellite navigation market 2010: analytical review. – M: 2011. http://aggf.ru/analitika/AGGF_2011.pdf
 - Introduction to Geographic Information Systems /Website "GIS-Lab and Authors" (<http://gis-lab.info/docs/giscourse>), Aug. 2007
 - Basic GIS - platform RECOD. <http://ssc.rekod.ru/content/services/3>
- 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 educational and methodological materials for independent work of students are posted in accordance with the current procedure on the discipline page in TUIS!

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