**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) developer of the educational program of higher education)

WORKING PROGRAM OF THE DISCIPLINE

GEOINFORMATION SYSTEMS AND APPLICATIONS

(name of discipline/module)

Recommended for the field of study/specialty:

27.04.04 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):

AIML and Space Sciences / Artificial Intelligence, Machine Learning and Space Sciences

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

2025

1. THE GOAL OF MASTERING THE DISCIPLINE

The discipline "Geoinformation Systems and Applications" is part of the master's program "Artificial Intelligence, Machine Learning and Space Sciences" in the direction 27.04.04 "Control in Technical Systems" and is studied in the 3rd semester of the 2nd year. The discipline is implemented by the Department of Mechanics and Control Processes. The discipline consists of 5 sections and 11 topics and is aimed at studying the fundamental principles of remote sensing of the earth, theoretical principles of organizing geoinformation systems, computer geoinformation technologies for processing spatio-temporal data; analysis of the main methods for solving typical problems and familiarization with the area of their application in professional activities.

The purpose of mastering the discipline is to form fundamental knowledge necessary for making informed decisions at all stages of using geographic information systems focused on the analysis of spatial (geographical) data, and to improve the general level of digital literacy of students.

2. REQUIREMENTS TO THE RESULTS OF MASTERING THE DISCIPLINE

Mastering the discipline " Geoinformation Systems and Applications " 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)
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-1.1 Knows the basic laws, provisions and methods in the field of natural sciences and mathematics; GPC-1.2 Able to identify the natural scientific essence of control problems in technical systems, guided by the laws and methods of natural sciences and mathematics; GPC-1.3 Has command of tools for analyzing control problems in technical systems.
GPC-9	Capable of developing methods and performing experiments on existing facilities with processing of results based on information technologies 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 perform experiments at existing facilities with processing of results using information technology.;
PC-2	Able to apply modern theoretical and experimental methods for developing mathematical models of objects and processes under study in the field of aerospace systems management	PC-2.1 Knows modern theoretical and experimental methods used to develop mathematical models of the objects under study and processes of professional activity; PC-2.2 Able to determine the effectiveness of the methods used to develop mathematical models of the objects and processes under study; PC-2.3 Has mastered modern theoretical and experimental methods for developing mathematical models of objects and processes of professional activity in the field of study.;

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

Discipline " Geoinformation Systems and Applications " 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 " Geoinformation Systems and Applications ".

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*
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	Virtual Reality and Computer Vision; Numerical Methods for Solving Mathematical Modeling Problems; Information Technology in Mathematical Modeling; Advanced Methods of Space Flight Mechanics; Advanced Methods of Earth Remote Sensing; Programming Technology;	Undergraduate Training;
GPC-9	Capable of developing methods and performing experiments on existing facilities with processing of results based on information technologies and technical means	Virtual Reality and Computer Vision;	Undergraduate Training;
PC-2	Able to apply modern theoretical and experimental methods for developing mathematical models of objects and processes under study in the field of aerospace systems management	Research work / Scientific research work; History and Methodology of Science; Virtual Reality and Computer Vision; *Artificial Neural Networks (Deep Learning)***; *Artificial Neural Networks (Deep Learning)***; Information Technology in Mathematical Modeling; Advanced Methods of Space Flight Mechanics;	Undergraduate Training;

* - 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 discipline "Geoinformation Systems and Applications" is 6 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)
			3
Contact work, academic hours	*72*		*72*
Lectures (LC)	36		36
Laboratory work (LW)	0		0
Practical/seminar classes (SC)	36		36
Independent work of students, academic hours	*108*		*108*
Control (exam/test with assessment), academic hours	*36*		*36*
General complexity of the discipline	**ac.h.**	**216**	*216*
	credit.ed.	**6**	*6*

5. CONTENT OF THE DISCIPLINE

*Table 5.1. Contents of the disci*plines (modules) 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	Geographic Information System: Overview, Software and Data, Spatial and Attribute Data, Vector and Raster Data, Layers, Networks, and Web Clients.	LC, LW, SC
		1.2	Open and Commercial GIS.	LC, LW, SC
		1.3	Thematic GIS applications.	LC, LW, SC
Section 2	Geographic information systems and spatial data	2.1	Data sources for GIS. Data entry problems.	LC, LW, SC
		2.2	Remote sensing as a data source.	LC, LW, SC
		2.3	Georeferencing and map projections in GIS.	LC, LW, SC
Section 3	Thematic mapping, surfaces and digital elevation model (DEM)	3.1	Compilation of thematic maps, types of digital elevation models, algorithms for working with DEMs, creation of 3D terrain models.	LC, LW, SC
		3.2	Integrated use of remote sensing data and geoinformation technologies in industry management	LC, LW, SC
Section 4	GIS analytical functions	4.1	Typical queries. Overlay.	LC, LW, SC
		4.2	Spatial queries in GIS	LC, LW, SC
Section 5	Designing the project style	5.1	Creating a map layout	LC, LW, SC

* - 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.	
Seminar	An auditorium for conducting seminar-type classes, group and individual consultations, ongoing monitoring and midterm assessment, equipped with a set of specialized furniture and technical means for multimedia presentations.	
For independent work	A classroom for independent work of students (can be used for conducting	

Audience type	Equipping the auditorium	Specialized educational/laboratory equipment, software and materials for mastering the discipline (if necessary)
	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. Baldina E.A. Labutina I.A. Deciphering aerospace images: textbook, [electronic publication of network distribution] / E.A. Baldina, I.A. Labutina. - 2nd ed., revised and supplemented. - M .: "KDU", "Dobrosvet", 2021 .-- 269 p.

2. 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.

3. 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.

4. 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.

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

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

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

8. Shikhov A.N., Cherepanova E.S., Pyankov S.V. Geoinformation systems: methods of spatial analysis: textbook / A.N. Shikhov, E.S. Cherepanova, S.V. Pyankov.Perm. state national research university – Perm, 2017 – 88 p.: ill.

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 geonets as elements of geospatial data exchange infrastructure // News of higher educational institutions. Geodesy and aerial photography, No. 1, 2014 pp. 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

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 https://mega.rudn.ru/MegaPro/Web

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

- EBS Yuraithttp://www.biblio-online.ru

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

- EBS "Znanium"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 "Geoinformation systems and their application".

* - all educational 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 of the Department of Mechanics and Control Processes		Dryga Danil Olegovich
Position, Department	*Signature*	*Surname I.O.*

HEAD OF THE DEPARTMENT:

Head of Department		Razumny Yuri Nikolaevich
Position of the Department	*Signature*	*Surname I.O.*

HEAD OF THE EP HE:

Head of Department		Razumny Yuri Nikolaevich
Position, Department	*Signature*	*Surname I.O.*