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

Academy of Engineering
(name of the main educational unit (POU) - developer of the EP HE)

COURSE SYLLABUS

GEOINFORMATION SYSTEMS AND APPLICATIONS
(name of discipline/module)

Recommended by the Didactic Council for the Education Field of:

27.04.04 CONTROL IN TECHNICAL SYSTEMS
(code and name of the area of training/specialty)

The discipline is mastered as part of the implementation of the main professional educational program of higher education:

DATA SCIENCE AND SPACE ENGINEERING
(name (profile/specialization) EP HE)

2024

1. GOAL OF DISCIPLINE MASTERING

The discipline “Geoinformation Systems and Applications” is included in the master’s program “Data Science and Space Engineering” 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 geographic information systems, computer geoinformation technologies for processing spatiotemporal data; analysis of the basic methods for solving typical problems and familiarization with the scope of their application in professional activities.

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

2. REQUIREMENTS FOR THE RESULTS OF MASTERING THE DISCIPLINE

Mastering the discipline “Geoinformation systems and application” is aimed at developing the following competencies (parts of competencies) in students:

Table 2.1. List of competencies formed in students when 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-1.1 Knows the basic laws, regulations 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 Possesses tools for analyzing management problems in technical systems.;
GPC-9	Able to develop methods and perform 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 existing facilities;; GPC-9.2 Has the skills to develop methods and conduct 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 control	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 for the development of mathematical models of the objects and processes under study;; PC-2.3 Masters modern theoretical and experimental methods for developing mathematical models of objects and processes of professional activity in the field of training.;

3. PLACE OF DISCIPLINE IN THE STRUCTURE OF HE EP

Discipline "Geoinformation systems and application" refers to the mandatory part of block 1 “Disciplines (modules)” of the educational program of higher education.

As part of the educational program of higher education, students also master other disciplines and/or practices that contribute to achieving the planned results of mastering the discipline “Geoinformation systems and application.”

Table 3.1. List of components of EP HE that contribute to achieving the planned results of mastering the discipline

Cipher	Name of competency	Previous disciplines/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 practice / Pre-graduate practice;
GPC-9	Able to develop methods and perform experiments at existing facilities with processing of results based on information technology and technical means	Virtual Reality and Computer Vision;	Undergraduate practice / Pre-graduate practice;
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 control	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 practice / Pre-graduate practice;

* - to be filled out in accordance with the competency matrix and SUP EP VO

** - elective disciplines/practices

4. SCOPE OF DISCIPLINE AND TYPES OF STUDY WORK

The total labor intensity 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 study.

Type of educational work	**TOTAL,**ac.ch.		**Semester(s)**
			3
Contact work, ac.ch.	*72*		*72*
Lectures (LC)	36		36
Laboratory work (LR)	0		0
Practical/seminar sessions (SZ)	36		36
Independent work of students, ac.ch.	*108*		*108*
Control (exam/test with assessment), academic degree.	*36*		*36*
Total labor intensity of the discipline	**ac.ch.**	***216***	*216*
	credit units	***6***	*6*

5. CONTENT OF DISCIPLINE

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

Section number	Name of the discipline section	Contents of the section (topic)		Type of educational 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, LR, SZ
		1.2	Open and Commercial GIS.	LC, LR, SZ
		1.3	Thematic GIS applications.	LC, LR, SZ
Section 2	Geographic information systems and spatial data	2.1	Data sources for GIS. Data entry problems.	LC, LR, SZ
		2.2	Remote sensing data as a source of data.	LC, LR, SZ
		2.3	Geographical reference and map projections in GIS.	LC, LR, SZ
Section 3	Thematic mapping, surfaces and digital elevation model (DEM)	3.1	Drawing up thematic maps, types of digital terrain models, algorithms for working with DEMs, creating 3D terrain models.	LC, LR, SZ
		3.2	Integrated use of remote sensing data and geographic information technologies in industry management	LC, LR, SZ
Section 4	Analytical functions of GIS	4.1	Typical requests. Overlay.	LC, LR, SZ
		4.2	Spatial queries in GIS	LC, LR, SZ
Section 5	Project style design	5.1	Create a map layout	LC, LR, SZ

* - to be filled out only for full-time education: LC – lectures; LR – laboratory work; SZ – practical/seminar classes.

6. MATERIAL AND TECHNICAL SUPPORT OF DISCIPLINE

Table 6.1. Material and technical support of the discipline

Audience type	Auditorium equipment	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; board (screen) and technical means of multimedia presentations.	
Seminar	An auditorium for conducting seminar-type classes, group and individual consultations, ongoing monitoring and intermediate certification, equipped with a set of specialized furniture and technical means for multimedia presentations.	
For independent work	An auditorium for independent work by students (can be used for seminars and	

Audience type	Auditorium equipment	Specialized educational/laboratory equipment, software and materials for mastering the discipline (if necessary)
	consultations), equipped with a set of specialized furniture and computers with access to EIOS.	

* - the audience for independent work of students is MANDATORY!

7. EDUCATIONAL, METHODOLOGICAL AND INFORMATIONAL SUPPORT OF DISCIPLINE

Main literature:

1. Baldina E.A. Labutina I.A. Interpretation of aerospace images: textbook, [electronic edition of network distribution] / E.A. Baldina, I.A. Labutina. – 2nd ed., revised and expanded. – M.: "KDU", "Dobrosvet", 2021. – 269 p.

2. Schowengerdt Robert A. Remote sensing. Models and methods of image processing / Shovengerdt R.A.; Kiryushin A.V., Demyanikov A.I. (translated from English). — 3rd ed. - M.: Tekhnosphere, 2013. - 589 p.

3. Monograph "State and prospects for using the results of space activities in the interests of modernizing the economy of the Russian Federation and developing its regions" / Makarov Yu.N., Bezborodov V.G., Zhiganov A.N. and etc.; under the general editorship of V.G. Bezborodova. – Moscow: JSC "Research Institute "ENTSITEKH", 2014. – 318 p.

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

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

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

7. Malin A.S. Regional management. Uch. State benefit University Higher School of Economics M.: ed. House of the State University of Higher School of Economics, 2006.

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

Additional literature:

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

2. Tikunov V.S., Kapralov E.G. Koshkarev A.V. and others. Fundamentals of geoinformatics. Textbook for universities.M. Academy. 2004, 2006

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

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

5. Directory of standard and commonly used (common) terms) on geodesy and cartography, topography, geographic information 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. Geographic information systems.Kudits-Press, 2009– 272 p.

7. Gruzinov V.S. System bases of geoinformation modeling of territories // Geodesy and cartography. - 2009. - No. 1 - p. 51-54

8. Gruzinov V.S. Knowledge system as an element of GIS information support // 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 geospatial data exchange infrastructure // 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

Resources of the information and telecommunications network "Internet":

1. EBS of RUDN University and third-party EBS, to which university students have access based on concluded agreements

- Electronic library system of RUDN University - EBS RUDN Universityhttp://lib.rudn.ru/MegaPro/Web
- EBS "University Library Online"http://www.biblioclub.ru
- EBS Lawhttp://www.biblio-online.ru
- EBS "Student Consultant"www.studentlibrary.ru
- EBS "Trinity Bridge"

2. Databases and search engines

- electronic fund of legal and regulatory technical documentationhttp://docs.cntd.ru/
- Yandex search enginehttps://www.yandex.ru/
- search systemGoogle https://www.google.ru/
- abstract databaseSCOPUS http://www.elsevierscience.ru/products/scopus/

Educational and methodological materials for students' independent work when mastering a discipline/module:*

1. A course of lectures on the discipline "Geoinformation systems and their application."

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

8. ASSESSMENT MATERIALS AND POINT-RATING SYSTEM FOR ASSESSING THE LEVEL OF COMPETENCIES FOR A DISCIPLINE

Evaluation materials and point-rating system* for assessing the level of development of competencies (parts of competencies) based on the results of mastering the discipline"Geographic information systems and their application" are presented in the Appendix to this Work Program of the discipline.

* - OM and BRS are formed on the basis of the requirements of the relevant local regulatory act of RUDN University.

DEVELOPERS:

Assistant professor		Dryga Danil Olegovich
Position	*Signature*	*Last name I.O.*
Senior Lecturer		Shemyakina Elizaveta Mikhailovna
Position	*Signature*	*Last name I.O*

HEAD OF DEPARTMENT:

Head of the department		Razumny Yuri Nikolaevich
Position	*Signature*	*Last name I.O.*

HEAD OF EP HE:

Professor		Razumny Yuri Nikolaevich
Position	*Signature*	*Last name I.O.*