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**Federal State Autonomous Educational Institution of Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA NAMED AFTER PATRICE LUMUMBA
RUDN University**

Academy of Engineering

(наименование основного учебного подразделения (ОУП)-разработчика ОП ВО)

COURSE SYLLABUS

GEOINFORMATION SYSTEMS AND APPLICATIONS

(name of discipline/module)

Recommended by the Didactic Council for the Education Field of:

21.04.01 OIL AND GAS ENGINEERING

(field of studies / speciality code and title)

The course instruction is implemented within the professional education programme of higher education:

Oil and Gas Engineering / Технологии добычи и транспортировки нефти и газа
higher education programme profile/specialisation title

2024 г.

1. COURSE GOAL(s)

The discipline «Geoinformation Systems and Applications» is included in the master's program « Oil and Gas Engineering » in the direction 21.04.01 «Oil and Gas Engineering» and is studied in the 2nd semester of the 1st 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, the theoretical principles of the organization of geoinformation systems, computer geoinformation technologies for processing spatial and temporal data; analysis of the main methods of solving typical tasks and acquaintance with the field of their application in professional activity.

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

2. REQUIREMENTS FOR LEARNING OUTCOMES

The development of the discipline "Geoinformation systems and their application" is aimed at the formation of the following competencies (parts of competencies) among students:

Table 2.1. List of competencies formed by students during the development of the discipline (results of the development of the discipline)

Competence code	Competence	Indicators of Competency Achievement (within this discipline)
GPC-4	Able to manage the system for monitoring the technical condition and technical diagnostics at the facilities and plants of the oil and gas complex	<p>GPC-4.1. Knows the technology of conducting standard experiments on standard equipment in the laboratory and in production; a complex of modern methods for processing the results of research, practical technical activities using existing equipment, instruments and materials.</p> <p>GPC-4.2. Can independently search, analyze and select the necessary information, organize, transform, store and transmit it; analyze the internal logic of scientific knowledge; justify their worldview and social position and apply the acquired knowledge in areas not related to professional activities; assess innovation risks; compare and process the results of research activities using standard equipment, instruments and materials.</p> <p>GPC-4.3 Has the technique of experimentation using software packages; the main directions of development of innovative technologies in the oil and gas industry; the skills in developing innovative approaches in specific technologies with the help of AWS.</p>
GPC-5	Able to evaluate the results of scientific and technical developments, scientific research and justify their own choice, systematizing and summarizing achievements in the oil and gas industry and related fields	<p>GPC-5.1. Knows the complex of modern technological processes and productions in the field of oil and gas engineering; the modern innovative achievements and scientific research carried out at the present stage; methods and principles of systematization and generalization of achievements in the oil and gas industry and related fields; main technologies for search, exploration and organization of oil and gas production in Russia and abroad, the standards and specifications, sources of information, mass media and multimedia technologies.</p> <p>GPC-5.2. Can consciously perceive information, independently search, extract, systematize, analyze and select information necessary for solving problems, organize, transform, store and transmit it; interpret the results of laboratory and technological studies in respect to specific conditions.</p> <p>GPC-5.3. Has the methods of collecting, processing and interpreting information received, using modern information technologies and applied hardware and software, methods of</p>

Competence code	Competence	Indicators of Competency Achievement (within this discipline)
		protecting, storing and presenting information.
SPC-1	Able to use theoretical knowledge when performing technological scientific research in the field of development, transportation and processing of oil and gas	<p>PC-1.1 Knows the fundamental concepts in the field of geology of oil and gas fields, the methods of forecasting, prospecting and exploration of mineral deposits; the regulatory and methodological documents in the field of hydrocarbon production and development of oil and gas fields.</p> <p>SPC-1.2 Can use theoretical knowledge and mining and geological information to carry out technological scientific research, as well as apply knowledge of regulatory and methodological documents to assess oil and gas fields</p> <p>SPC-1.3 Has the theoretical knowledge, methods of subsurface research in the field of oil and gas field development; skills to perform production, technological and engineering research in the field of hydrocarbon production, development of oil and gas fields.</p>

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The discipline "Geoinformation systems and application" belongs to the mandatory part of block 1 "Disciplines (modules)" of the educational program of higher education.

Within the framework 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. The list of the higher education programme components that contribute to the achievement of the expected learning outcomes as the internship results

Competence code	Competence descriptor	Previous courses / modules, internships *	Subsequent courses / modules, internships
GPC-4	Able to manage the system for monitoring the technical condition and technical diagnostics at the facilities and plants of the oil and gas complex		Information technologies in the oil and gas industry; Current development of the production of unconventional hydrocarbon resources in the world;
GPC-5	Able to evaluate the results of scientific and technical developments, scientific research and justify one's own choices, systematizing and summarizing achievements in the oil and gas industry and related fields	History and methodology of subsoil use;	Research work (obtaining primary research skills);
SPC-1	Able to use theoretical knowledge when performing technological scientific research in the field of development and transportation of oil and gas	<i>Advanced oil and gas processing equipment and product quality management**;</i>	<i>Comprehensive analysis of processing, storage and marketing of hydrocarbons**;</i> Current development of the production of unconventional hydrocarbon resources in the world; <i>Innovative technologies for the transportation and storage of hydrocarbons**;</i> Research work (obtaining primary research skills)); Research Work; Pre-graduation Practical Training;

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4. COURSE WORKLOAD

The total workload of the course «Geoinformation Systems and Applications» is «3» credits.

Table 4.1. Academic activities types by periods of the higher education programme

Type of academic activities	Total academic hours,		Semester(s)
			2
<i>Contact work, ac. h..</i>	51		51
Lectures (LC)	17		17
Lab works (LW)	34		34
Seminars (workshops / tutorials) (S)	0		0
<i>Self-studies academic hours</i>	57		57
<i>Evaluation and assessment academic hours</i>	0		0
Course workload	academic hours	108	108
	credits	3	3

5. COURSE CONTENTS

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

№	Modules	Contents (topics)		Academic activities types
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, S
		1.2	Open and Commercial GIS.	LC, LW, S
		1.3	Thematic GIS applications.	LC, LW, S
Section 2	Geoinformation systems and spatial data	2.1	Data sources for GIS. Data entry problems.	LC, LW, S
		2.2	Remote sensing as a data source.	LC, LW, S
		2.3	Geographic reference and cartographic projections in GIS.	LC, LW, S
Section 3	Thematic mapping, surfaces and digital terrain model (DEM)	3.1	Compilation of thematic maps, types of digital terrain models, algorithms for working with DEM, creation of 3D terrain models.	LC, LW, S
		3.2	Integrated use of remote sensing data and geoinformation technologies in industry management	LC, LW, S
Section 4	Analytical functions of GIS	4.1	Typical requests. Overlay.	LC, LW, S
		4.2	Spatial queries in GIS	LC, LW, S
Section 5	Design of the map project style	5.1	Creating a map layout	LC, LW, S

6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Classroom equipment and technology support requirements

Type of academic activities	Classroom equipment	Specialized educational / laboratory equipment, software and materials for course study (if necessary)
Lectures	An auditorium for conducting lectures, equipped with a set of specialized furniture; a blackboard (screen) and technical means for multi-media presentations.	
Lab works	An auditorium for laboratory work, equipped with a set of specialized furniture and equipment.	Computer laboratory
Computer Labs	A classroom for conducting classes, group and individual consultations, current and mid-term assessment, equipped with personal computers (in the amount of 14 pcs), a board (screen) and technical means of multimedia presentations.	Software: Autodesk Revit Autodesk Navisworks
Self-studies	A classroom for independent work of students (can be used for seminars and consultations), equipped with a set of specialised furniture and computers with access to the electronic information and educational environment	

7. RESOURCES RECOMMENDED FOR INTERNSHIP

Main readings:

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

2. Robert A. Shovengert, Remote sensing. Models and methods of image processing / shovengerdt R.A.; Kiryushin A.V., Demyanikov A.I. (in trans. see). — 3rd ed. - M.: Technosphere, 2013. - 589 p.

3. Monograph "The state 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., etc.; edited by V.G. Bezborodov. - Moscow: CJSC "Research Institute "ENZITECH", 2014. - 318 p.

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

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

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

7. A. Malinovsky.C. Regional management. The teaching manual of the state. University of the Higher School of Economics, Moscow:ed. House of GOUVE, 2006.

8. Shikhov A.N., Cherepanova E.S., Pyankov S.V. Geoinformation systems: methods of spatial analysis: textbook. handbook /A.N. Shikhov, E.S. Cherepanova, S.V. Pyankova. Perm. state National issl.un-ta. – Perm, 2017-88 P.: ill.

Additional readings:

1. Geoinformatics: in 2 books: textbook for students of higher educational institutions / Kapralov E.G., Koshkarev A.V., Tikunov V.S., etc.; ed. Tikunova V.S. – 2nd ed., reprint. 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 satellite images: textbook. // Lurie I.K. - 2nd edition, revised – Moscow: KDU, 2010.

4. Mirtova I.A., Topographic decryption of Land and urban cadastre objects. Textbook - M.:–Publishing house of MIIGAiK, 2007 -120 p.

5. Handbook of standard and used (common) terms) on geodesy and cartography, topography, geoinformation systems, spatial data// Alexandrov 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. System 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 GIS information support // Izvestiya vuzov. Geodesy and aerial photography. - 2009. - No. 3 - pp. 72-75

9. Gruzinov V.S. Prospects for the development of GIS software functionality // Izvestiya vuzov. Geodesy and aerial photography. - 2009. No. 6 - pp.89-91

10. Gruzinov V.S. Geoportals and geosets as elements of the geospatial data exchange infrastructure // Izvestia 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, pp. 34-39

Internet sources

Electronic libraries (EL) of RUDN University and other institutions, to which university students have access on the basis of concluded agreements:

- RUDN Electronic Library System (RUDN ELS) <http://lib.rudn.ru/MegaPro/Web>
- EL "University Library Online" <http://www.biblioclub.ru>
- EL "Yurayt" <http://www.biblio-online.ru>
- EL "Student Consultant" www.studentlibrary.ru
- EL "Lan" <http://e.lanbook.com/>
- EL "Trinity Bridge"

2. Databases and search engines:

- electronic foundation of legal and normative-technical documentation <http://docs.cntd.ru/>
- Yandex search engine <https://www.yandex.ru/>
- Google search engine <https://www.google.ru/>
- Scopus abstract database <http://www.elsevier.com/locate/scopus/>

1. *The training toolkit and guidelines for a student «Geoinformation System and Application».*

8. ASSESSMENT TOOLKIT AND GRADING SYSTEM* FOR EVALUATION OF STUDENTS' COMPETENCES LEVEL AS INTERNSHIP RESULTS

The assessment toolkit and the grading system* to evaluate the level of competences (competences in part) formation as the course Geoinformation System and Application results are specified in the Appendix to the internship syllabus.

* The assessment toolkit and the grading system are formed on the basis of the requirements of the relevant local normative act of RUDN University (regulations / order).

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