Federal State Autonomous Educational Institution for Higher Education
PEOPLES' FRIENDSHIP UNIVERSITY OF RUSSIA
NAMED AFTER PATRICE LUMUMBA
(RUDN University)

Academy of Engineering
educational division (faculty/institute/academy) as higher education programme developer

COURSE SYLLABUS

Digital Technologies in Geology
course title

Recommended by the Didactic Council for the Education Field of:

05.04.01 Geology
field of studies / speciality code and title

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

Mining Geology
higher education programme profile/specialisation title

2025

1. COURSE GOAL(s)

The goal of the course “Digital Technologies in Geology” is to acquire knowledge, skills and experience in the field of digital computer technology in solving various geological problems. Additionally, it involves characterizing the stages of competence formation and ensuring the achievement of the planned results of the educational programme.

The main objectives of the course are:

- to acquaint students with the capabilities of modern computer programs used for geological surveying, prospecting, exploration, and development of mineral deposits as well as for conducting research work.

- to teach students how to independently master new software tools in minimal time, based on the general principles of designing application software packages.

- to train students in transforming (formalizing) geological data into formats suitable for machine processing.

2. REQUIREMENTS TO LEARNING OUTCOMES

The course implementation is aimed at the development of the following competences (competences in part):

Table 2.1. List of competences that students acquire during the course

Competence code	**Competence descriptor**	**Competence formation indicators** (within this course)
GC-1	Able to critically analyze problem situations on the basis of a systematic approach, develop a strategy of action.	GC-1.1. Analyzes the problem, identifying its basic components; GC-1.2. Performs information retrieval for solving the task by various types of inquiries; GC-1.3. Suggests options for solving the problem, analyzes the possible consequences of their use.
GC-7	Capable: - of searching for the necessary sources of information and data, perceive, analyze, memorize and transmit information using digital means, as well as using algorithms when working with data received from various sources in order to effectively use the information received to solve problems; - of evaluating information, its reliability, build logical conclusions based on incoming information and data.	GC-7.1 Searches for relevant sources of information and data, perceives, analyzes, remembers and communicates information using digital tools and algorithms when working with data from various sources in order to effectively use the information to solve problems; GC-7.2 Evaluates information, its reliability, and draws logical conclusions from incoming information and data.

Competence code	Competence descriptor	Competence formation indicators (within this course)
GPC-4	Suitable of representing, protecting, and disseminating the outcomes of their professional activities.	GPC-4.1 Knows the main results of his/her scientific activity, methods of their presentation, protection and dissemination; GPC-4.2. Knows how to understand and analyze the results of professional activities, use own scientific achievements. discuss and disseminate the results of their professional activities; GPC-4.3. Has the skills to analyze, discuss and disseminate the results of professional activities.
PC-1	Capable of processing geological data, modeling ore bodies with modern software, resolving quality and mineral reserve management issues, and developing engineering and geological surveying measures for the territory.	PC-1.1. Knows the basics of geological structure of ore deposits, the possibility of using specialized software

3. COURSE IN HIGHER EDUCATION PROGRAMME STRUCTURE

The course refers to the variable component of (B1) block of the higher educational programme curriculum.

Within the higher education programme students also master other (modules) and / or internships that contribute to the achievement of the expected learning outcomes as results of the course study.

Table 3.1. The list of the higher education programme components/disciplines that contribute to the achievement of the expected learning outcomes as the course study results

Competence code	Competence descriptor	Previous courses/modules	Subsequent courses/modules
GC-1	Able to critically analyze problem situations on the basis of a systematic approach, develop a strategy of action.		Geoinformation Systems for Geology Based on Space Imagery; Innovative Remote Sensing Methods in Geology; Graduate Qualification Work; Information Databases
GC-7	Capable: - of searching for the necessary sources of information and data, perceive, analyze, memorize and transmit information using digital		Modelling of Mineral Deposits; Graduate Qualification Work

Competence code	Competence descriptor	Previous courses/modules	Subsequent courses/modules
	means, as well as using algorithms when working with data received from various sources in order to effectively use the information received to solve problems; - of evaluating information, its reliability, build logical conclusions based on incoming information and data.		
GPC-4	Suitable of representing, protecting, and disseminating the outcomes of their professional activities.		Sustainable Mining; Work Experience Internship; Research Work; Graduate Qualification Work
PC-1	Capable of processing geological data, modeling ore bodies with modern software, resolving quality and mineral reserve management issues, and developing engineering and geological surveying measures for the territory.		Geological and Geophysical Basics of Mineral Prospecting and Exploration; Modelling of Mineral Deposits; Pre-Graduation Practice; Graduate Qualification Work

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total workload of the course “Digital Technologies in Geology” is 7 credit units.

Table 4.1. Types of academic activities during the periods of higher education programme mastering

Type of academic activities		TOTAL, ac. hrs.	Semesters/ training modules	
			1	**2**
Contact academic hours		*90*	*54*	*36*
Lectures (LC)		-	-	-
Lab work (LW)		-	-	-
Seminars (workshops/tutorials) (S)		90	54	36
Self-studies		*126*	*63*	*63*
Evaluation and assessment (exam/passing/failing grade)		*36*	*27 Exam*	*9 Failing grade*
Course workload	academic hours	**252**	**144**	**108**
	credits	**7**	**4**	**3**

5. COURSE CONTENTS

Table 5.1. Course contents and academic activities types

Course module title	Course module contents (topics)	Academic activities types
Module 1. General issues of computer processing of geological information	1.1. Sources and types of geological information, formalization of geological data. Computer representation of raster, vector, numeric and text data, file formats, format conversion, converters	S
Module 2. Specialized computer programs used to solve geological problems	2.1. Graphic and text editors for commercial and free use	S
	2.2. Programs for analyzing and displaying numerical data. Vectorizers. Programs to build maps in isolines, borehole columns. Programs for processing remote sensing data	S
Module 3. General issues of geoinformatics. Organization and visualization of data in GIS	3.1. Geographic information systems (GIS), areas of application, structure, software and hardware	S
	3.2. Sources and types of data, input and storage of spatially coordinated and attributive data. Vector and raster data, geodatabases	S
Module 4. Spatially coordinated and attributive data transformation and analysis in GIS	4.1. Projection, curvilinear and affine transformations, scaling and generalization. Basic operations with raster data (layer displaying, recoding, overlaying, filtering, calculation of slope, aspect ratio, distances, perimeters, areas, buffer zones and visibility zones detection). Basic operations with vector data (mapping, splitting and merging, topographic overlay, buffering, discrete georeferencing (geocoding). Basic operations with attributive data (statistical analysis, plotting, interpolation). Expert systems	S
Module 5. Applied aspects of geoinformatics	5.1. Requirements for the content of databases. Comparative characteristics of the basic tools and software GIS. Examples of GIS implementation. Prospects and trends in the development of geoinformatics in Russia and abroad.	S

** LC - lectures; LW - lab work; S - seminars.*

6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Classroom equipment and technology support requirements

Type of academic activities	Classroom equipment	Specialised educational / laboratory equipment, software, and materials for course study (if necessary)
Computer Lab	A classroom for conducting classes, group and individual consultations, current and mid-term assessment, equipped with personal	Specialized software: • ArcGIS, • QGIS,

	computers (in the amount of 24 pcs), a board (screen) and technical means of multimedia presentations.	• SAGA, • STATISTICA, • Surfer, • Erdas Emagine, • Isoline
Computer Lab	A classroom for conducting classes, group and individual consultations, current and mid-term assessment, equipped with personal computers (24 pcs.), a board (screen) and technical means of multimedia presentations.	
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 COURSE STUDY

Main reading:

1. Reference systems embedded in QGIS, SAGA, ArcGIS, STATISTICA, Surfer, Erdas Emagine, Isoline

2. Zakharov M.S., Kobzev A.G. Cartographic method and geoinformation systems in engineering geology. Publisher: Lan', 2019. - 116 c. ISBN: 5978-5-8114-4641-4; Same [Electronic resource]. - URL: http://biblioclub.ru/index.php?page=book&id=57174

3. Geoinformation systems : textbook / compilers O.L. Giniyatullina, T.A. Khorosheva. - Kemerovo : KemSU, 2018. - 122 c. - ISBN 978-5-8353-2232-9. - Text : electronic // Lan' : electronic library system. - URL: https://e.lanbook.com/book/120040 - Mode of access: for authorized users.

Additional reading:

1. Dubrovskiy A. V. Geoinformation systems: automated mapping : tutorial / A. V. Dubrovskiy. - Novosibirsk : SGUGiT, 2021. - 121 c. - ISBN 978-5-907320-82-6. - Text : electronic // Lan' : electronic library system. - URL: https://e.lanbook.com/book/222332 - Mode of access: for authorized users.

2. Geoinformation systems: laboratory practical work : [16+] / author-compiler. O. E. Zelivyanskaya ; North Caucasian Federal University. - Stavropol : North Caucasian Federal University (NCFU), 2017. - 159 c. : ill. - Access mode: by subscription. - URL: https://biblioclub.ru/index.php?page=book&id=483064 - Text : electronic.

Internet sources:

1. 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" http://www.trmost.ru

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.elsevierscience.ru/products/scopus/

*Training toolkit for self- studies to master the course *:*

1. Guidelines for students on the development of the course "Digital Technologies in Geology".

* The training toolkit for self- studies to master the course is placed on the course page in the university telecommunication training and information system under the set procedure.

8. ASSESSMENT TOOLKIT AND GRADING SYSTEM* FOR EVALUATION OF STUDENTS' COMPETENCES LEVEL UPON COURSE COMPLETION

The assessment toolkit and the grading system* to evaluate the competences formation level (competences in part) upon the course study completion are specified in the Appendix to the course 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).

DEVELOPERS:

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