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

Modeling of Mineral Deposits

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 "Modeling of Mineral Deposits" is to acquire knowledge, skills and experience in the field of analysis and interpretation of geological information, as well as the construction of 2D and 3D models of subsurface sites in accordance with the task and using modern mining and geological information systems. 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:

- studying and analyzing modern methods and approaches in constructing resource, lithological, and other types of geological models;

- forming skills and abilities in constructing framework and block models of subsurface sites;

- studying and analyzing the range of modern geostatistical analysis methods;

- acquiring skills in working with modern mining and geological information systems to solve problems related to professional activities according to the curriculum profile.

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-2	Able to manage a project at all stages of its life cycle.	GC-2.1. Formulates a problem whose solution is directly related to the achievement of the project goal; GC-2.2 Identifies the connections between the tasks and the expected results of their solution; GC-2.3 Identifies the available resources and constraints within the assigned tasks and the applicable legal regulations.
GC-6	Able to identify and implement the priorities of their own activities and ways to improve it based on self-assessment.	GC-6.1 Controls the amount of time spent on specific activities; GC-6.2. Develops time management tools and methods for accomplishing specific tasks, projects, and goals; GC-6.3 Analyzes one's resources and their limits (personal, situational, time, etc.) to successfully complete the assigned task.

Competence code	Competence descriptor	Competence formation indicators (within this course)
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.
GPC-2	Able of independently formulating the research objectives and establishing a sequence for resolving professional problems.	GPC-2.1. Knows the basics and methods of organizing research activities, methods of setting goals and methods of achieving them; GPC-2.2. Knows how to develop research methods; GPC-2.3. Has methods of establishing cause-effect relationships and identifying the most significant among them and skills of independent formulation of research objectives.
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; PC-1.2. Knows how to apply methods of geological data processing, build ore body models, solve problems on quality and mineral reserves management, develop measures for engineering and geological study of the territory; PC-1.3. Has the skills to process geological data and construct ore body models using modern software.
PC-2	Capable of justifying the need, choosing the best methodology, planning, implementing, interpreting results, and supervising geophysical work at various stages of mineral site development.	PC-2.1. Knows the theoretical basics of geophysical research; PC-2.2 Knows how to select the best methodology, design, implement, interpret the results of geophysical works.

Competence code	Competence descriptor	Competence formation indicators (within this course)
PC-4	Capable of designing, assisting with, and supervising a geologic study of a subsoil area at various stages of development.	PC-4.1 Knows the theoretical basis and methods of geological study of the subsoil area at various stages of its development; PC-4.2 Knows how to apply methodological solutions in the design and implementation of the geological study of a subsoil area at various stages of its development.

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-2	Able to manage a project at all stages of its life cycle.		Groundwater Dinamics; Applied Groundwater Modeling; Graduate Qualification Work
GC-6	Able to identify and implement the priorities of their own activities and ways to improve it based on self-assessment.		Graduate Qualification Work
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.		Graduate Qualification Work
GPK-2	Able of independently formulating the research		Research Work (Mining Geology). Part 1; Research Work

Competence code	Competence descriptor	Previous courses/modules	Subsequent courses/modules
	objectives and establishing a sequence for resolving professional problems.		(Geological and Geophysical Survey). Part 1; Research Work (Mining Geology). Part 2; Research Work (Geological and Geophysical Survey). Part 2; Applied Groundwater Modeling; Graduate Qualification Work
SPC-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.		Pre-graduation Practical Training; Research Work (Geological and Geophysical Survey). Part 1; Research Work (Mining Geology). Part 1; Research Work (Geological and Geophysical Survey). Part 2; Research Work (Mining Geology). Part 2; Graduate Qualification Work
SPC-2	Capable of justifying the need, choosing the best methodology, planning, implementing, interpreting results, and supervising geophysical work at various stages of mineral site development.		Research Work (Geological and Geophysical Survey). Part 1; Research Work (Mining Geology). Part 1; Research Work (Geological and Geophysical Survey). Part 2; Research Work (Mining Geology). Part 2; Pre-graduation Practical Training; Mining Hydrogeology; Graduate Qualification Work
PC-4	Capable of designing, assisting with, and supervising a geologic study of a subsoil area at various stages of development.		Pre-graduation Practical Training; Research Work (Geological and Geophysical Survey). Part 1; Research Work (Mining Geology). Part 1; Research Work (Geological and Geophysical Survey). Part 2; Research Work (Mining Geology). Part 2; Mining Hydrogeology; Graduate Qualification Work

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

The total workload of the course "Modeling of mineral deposits" 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		*70*	*36*	*34*
Lectures (LC)		-	-	-
Lab work (LW)		-	-	-
Seminars (workshops/tutorials) (S)		70	36	34
Self-studies		*164*	*72*	*92*
Evaluation and assessment (exam/passing/failing grade)		*18*	*0 Failing grade*	*18 Exam*
Course workload	academic hours	**252**	**108**	**144**
	credits	**7**	**3**	**4**

5. COURSE CONTENTS

Table 5.1. Course contents and academic activities types

Modules	Topics	Type of academic activities*
Module 1. Modeling in mining: types, main tasks and methods:	1.1. modeling in geology and mining; 1.2. statistical processing of geological data; 1.3. initial data for geological modeling at the stage of exploration and development of the deposit; 1.4. formation of a database containing initial geological data to build a block model of a solid mineral deposit. Search for errors in the geological database; 1.5. calculation of the conditional component for complex fields;	S
Module 2. Mining and geological information systems:	2.1. mining and geological information systems, the main functionality and differences of software products.	S
Module 3. Outlining and construction of wireframe models of ore deposits:	3.1. delineation of ore bodies; 3.2. conditions and their interpretation in geometric and mathematical modeling; 3.3. wireframe modeling; 3.4. delineation of ore bodies in sections using a mining and geological information system; 3.5. substantiation of conditional parameters based on a variant enumeration (cut-off grade, minimum thickness of ore bodies, maximum thickness of barren interlayers); 3.6. operations on frames; 3.7. construction of a lithological model of an ore deposit.	S
Module 4. Block modeling of ore deposits of minerals:	4.1. block modeling; 4.2. construction of a block model of an ore deposit in a mining and geological information system; 4.3. selection and justification of the size of the elementary unit of the block model;	S

Modules	Topics	Type of academic activities*
	4.4.block model evaluation; 4.5.evaluation of the block model in the mining and geological information system.	
Module 5. Fundamentals of geostatistics:	5.1.basic geostatistical methods; 5.2.application of the IDW - method in modeling ore deposits of minerals. 5.3.substantiation of the parameters of the search ellipse based on the variability of the properties of geological bodies.	S
Module .6. Dynamic geological models:	6.1.conditional modeling in modern mining and geological information systems; 6.2.frameless modeling; 6.3.application of neural network and other technologies for field modeling; 6.4.topographic surface modeling using neural networks; 6.5.the use of dynamic geological models in modern mining industry; 6.6.basics of simulation modeling: its scope, basic methods and approaches, experience in using simulation models to solve mining and geological problems.	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 computers, a board (screen) and technical means of multimedia presentations.	Specialized software: • Micromine, • GIS GEOMIX, • QGIS.
Seminar	A classroom for conducting seminars, group and individual consultations, current and mid-term assessment; equipped with a set of specialised furniture and technical means for 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.   Ashoke K. Talapatra. "Geochemical Exploration and Modelling of Concealed Mineral Deposits". Springer Cham, 2020 - https://doi.org/10.1007/978-3-030-48756-0

2.   Andy J. Howard, Chris Carey, David Knight, Jane Corcoran, Jen Heathcote. "Deposit Modelling and Archaeology". Historic England, 2020 - https://historicengland.org.uk/images-books/publications/deposit-modelling-and-archaeology/

3.   Jacqui Coombes. "The Art and Science of Resource Estimation". Coombes Capability, 2008 - https://www.geokniga.org/bookfiles/geokniga-art-and-science-resource-estimation.pdf

Additional reading:
1.   Mario E. Rossi, Clayton V. Deutsch. "Mineral Resource Estimation". Springer Dordrecht, 2013 - https://doi.org/10.1007/978-1-4020-5717-5

2.   Ye Zhang "Introduction to Geostatistics". University of Wyoming, 2011 - http://geofaculty.uwyo.edu/yzhang/files/Geosta1.pdf

3.   Mohammad Ehteram, Zohreh Sheikh Khozani, Saeed Soltani-Mohammadi, Maliheh Abbaszadeh. "Estimating Ore Grade Using Evolutionary Machine Learning Models". Springer Singapore, 2022 - https://doi.org/10.1007/978-981-19-8106-7

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 "Modeling of Mineral Deposits".
* 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:

Associate Professor, Geology and Survey Department, MISIS	**V. Cheskidov**
position, educational department	name and surname

Senior Lecturer, Geology and Survey Department, MISIS	**A. Lipina**
position, educational department	name and surname

HEAD OF EDUCATIONAL DEPARTMENT:

Department of Subsoil Use and Oil&Gas Engineering	**A. Kotelnikov**
educational department	name and surname

HEAD OF
HIGHER EDUCATION PROGRAMME:

Head of the Department of Subsoil Use and Oil&Gas Engineering	**A. Kotelnikov**
position, educational department	name and surname