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

Academy of Engineering
(name of the educational division - developer of the HEP HE)

COURSE SYLLABUS

Modeling of mineral deposits
(Subject / Course title)

Recommended by the Didactic Council for the Education Field of:

05.04.01 Geology
(code and name of the Higher Education Field)

The development of the discipline is carried out within the framework of the implementation of the Higher Education Programme of Higher Education (HEP HE):

Mining Geology
(name (profile/specialization) of the Higher Education Program)

2023

1. AIMS AND OBJECTIVES

The purpose of mastering the discipline "Modeling of mineral deposits" is:

- acquiring 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 subsoil plots in accordance with the task and using modern mining and geological information systems that characterize the stages of competence formation and ensuring the achievement of the planned results of the educational programme.

The main objectives of the discipline are:

- study and analysis of modern methods and approaches in the construction of resource, lithological and other types of geological models;
- formation of skills and abilities in the field of constructing frame and block models of subsoil plots;
- study and analysis of the scope of modern methods of geostatistical analysis;
- acquisition of skills in working with modern mining and geological information systems to solve problems in the field of professional activity in accordance with the profile of the educational program.

2. REQUIREMENTS TO LEARNING OUTCOMES

Mastering the discipline "Modeling of mineral deposits" is aimed at developing the following competencies (parts of competencies) among students:

Table 2.1. The list of competencies formed by students in the course of mastering the discipline (the results of mastering the discipline)

Code	Competence	Competence Formation Indicators (within this discipline)
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 Analyze one's resources and their limits (personal, situational, time, etc.) to successfully complete the assigned task.
GC-7	Capable: - search for the necessary sources of information and data, perceive, analyze, memorize and transmit information using digital	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;

Code	Competence	Competence Formation Indicators (within this discipline)
	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; - evaluate information, its reliability, build logical conclusions based on incoming information and data.	GC-7.2 Evaluates information, its reliability, and draws logical conclusions from incoming information and data.
GPK-2	Able of independently formulating the research objectives and establishing a sequence for resolving professional problems.	GPK-2.1. Knows the basics and methods of organizing research activities, methods of setting goals and methods of achieving them;
		GPK-2.2. is able to develop research methods;
		GPK-2.3. has methods of establishing cause-effect relationships and identifying the most significant among them and skills of independent formulation of research objectives.
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.	PC-1.1. Knowledge of the basics of geological structure of ore deposits, the possibility of using specialized software;
		PC-1.2. Is able 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. Have the skills to process geological data and build models of ore bodies using modern software.
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.	PC-2.1. Know the theoretical basics of geophysical research;
		PC-2.2 Know how to select the best methodology, design, implement, interpret the results of geophysical works;
SPC-4	Capable of designing, assisting with, and supervising a geologic study of a subsoil area at various stages of development.	PC-4.1 Know the theoretical basis and methods of geological study of the subsoil area at various stages of its development;
		PC-4.2 Be able to apply methodological solutions in the design and implementation of the geological study of a subsoil area at various stages of its development;

3. THE PLACE OF DISCIPLINE IN THE STRUCTURE OF HEP HE

Discipline “Modeling of mineral deposits” refers to the Variable Component of block B1 of the HEP HE.

As part of the HEP HE, students also master other disciplines and / or practices that contribute to the achievement of the planned results of mastering the discipline "Modeling of mineral deposits".

Table 3.1. The list of components of the HEP HE that contribute to the achievement of the planned results of the development of the discipline

Code	Competence	Previous Disciplines (Modules)*	Subsequent Disciplines (Modules)*
GC-2	Able to manage a project at all stages of its life cycle.		Groundwater Dinamics; Applied Groundwater Modeling; Final state attestation
GC-6	Able to identify and implement the priorities of their own activities and ways to improve it based on self-assessment.		Final state attestation
GC-7	Capable: - search 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; - evaluate information, its reliability, build logical conclusions based on incoming information and data.		Final state attestation
GPK-2	Able of independently formulating the research objectives and establishing a sequence for resolving professional problems.		Research Work (Mining Geology). Part 1; Research Work (Geological and Geophysical Survey). Part 1; Research Work (Mining Geology). Part 2; Research Work (Geological and Geophysical Survey). Part 2; Applied Groundwater Modeling; Final state attestation
SPC-1	Capable of processing geological data, modeling ore bodies with modern software, resolving		Pre-graduation Practical Training; Research Work (Geological and Geophysical Survey). Part 1; Research

Code	Competence	Previous Disciplines (Modules)*	Subsequent Disciplines (Modules)*
	quality and mineral reserve management issues, and developing engineering and geological surveying measures for the territory.		Work (Mining Geology). Part 1; Research Work (Geological and Geophysical Survey). Part 2; Research Work (Mining Geology). Part 2; Final state attestation
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; Final state attestation
SPC-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; Final state attestation

* - filled in in accordance with the matrix of competencies and academic curriculum of HEP HE

4. COURSE WORKLOAD AND ACADEMIC ACTIVITIES

Course workload "Modeling of mineral deposits" is 7 credit units.

Table 4.1. Types of academic activities during the period of the HE programme mastering

Type of academic activities		TOTAL, ac. hrs.	Semester	
			1	2
Contact academic hours		*70*	*36*	*34*
Lectures		-	-	-
Lab work		-	-	-
Seminars (workshops/tutorials)		70	36	34
Self-study (ies), academic hours		*164*	*72*	*92*
Evaluation and assessment (exam or pass/fail grading)		*18*	*0 fail grading with grade*	*18 Exam*
Course workload	academic hours	**252**	**108**	**144**
	credits	**7**	**3**	**4**

5. COURSE MODULES AND CONTENTS

Table 5.1. Course Modules and Contents by types of academic activities

Modules	Topics	Type of academic activities*
Section 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;	Sem
Section 2. Mining and geological information systems:	2.1. mining and geological information systems, the main functionality and differences of software products.	Sem
Section 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.	Sem
Section 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; 4.4. block model evaluation; 4.5. evaluation of the block model in the mining and geological information system.	Sem

Modules	Topics	Type of academic activities*
Section 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.	Sem
Section .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.	Sem

* - *Lec – Lectures; Lab – Lab work; Sem – Seminars (workshops/tutorials).*

6. CLASSROOM EQUIPMENT AND TECHNOLOGY SUPPORT REQUIREMENTS

Table 6.1. Classroom Equipment and Technology Support Requirements

Classroom for Academic Activity Type	Classroom Equipment	Specialized educational / laboratory equipment, software and materials for mastering the discipline (if necessary)
Computer Lab	Computer lab for conducting classes, group and individual consultations, current control and intermediate attestation, equipped with personal computers (21 pcs. computer class equipped with 21 personal computers, a blackboard (screen) and multimedia devices. technical means of multimedia presentations.	Specialized software: • MS Office licensed software package, • Micromine, • GIS GEOMIX, • QGIS.
Seminars	Auditorium for classes seminars, group and individual consultations, current control and	

	intermediate attestation, equipped with a set of a set of specialized furniture and technical means of multimedia presentations.	
Self-studies	Auditorium for independent work (can be used for seminars and consultations), equipped with a set of a set of specialized furniture and computers with access to the EITS of the university.	

7. RECOMMENDED SOURCES FOR COURSE STUDIES

Main reading(sources):

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 (optional) reading (sources):

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-(based) sources:

1. Electronic libraries with access for RUDN students:
- RUDN Electronic Library System – RUDN ELS http://lib.rudn.ru/MegaPro/Web
- ELS “University Library Online” http://www.biblioclub.ru
- ELS Yurayt http://www.biblio-online.ru
- ELS “Student Consultant” www.studentlibrary.ru
- ELS “Lan” http://e.lanbook.com/
- ELS “Trinity Bridge” http://www.trmost.ru

2. Databases and search engines:

- Electronic Fund of Legal and Normative-technical Documentation http://docs.cntd.ru/

- Yandex search engine https://www.yandex.ru/

- Google search engine https://www.google.ru/

- abstract database SCOPUS http://www.elsevierscience.ru/products/scopus/

*Learning toolkits for self- studies in the RUDN LMS TUIS *:*

1. Guidelines for students on the development of the subject "Modeling of mineral deposits".

* - all educational and methodological materials for independent work of students are placed in accordance with the current procedure on the page of the subject **in LMS TUIS**!

8. ASSESSMENT AND EVALUATION TOOLKIT AND GRADING CRITERIA

Assessment and Evaluation Toolkit (AET), Grading System (GS)* for assessing the level of competence (part of competence) for the subject "Modeling of mineral deposits" are presented in the Appendix to the Course Syllabus of the subject.

* - AET and GS are formed on the basis of the requirements of the relevant local normative act of the RUDN University.

DEVELOPERS:

Associate Professor, Geology and Survey Department		**V. Cheskidov**
Position, Department	Signature	Full name
Senior Lecturer, Geology and Survey Department		**A. Lipina**
Position, Department	Signature	Full name

HEAD of Department:

Director of the Department of Subsoil Use and Oil&Gas Engineering		**A. Kotelnikov**
Name of Department	Signature	Full name

HEAD OF HEP HE:

Director of the Department of Subsoil Use and Oil&Gas Engineering		**A. Kotelnikov**
Position, Department	Signature	Full name