Mining and metallurgy Institute named after O.A.Baikonurov

Mining Department

EDUCATIONAL PROGRAM

8D07211- " Digital modelling of mining and geomechanical processes "

Code and classification of the field of education:	8D07 – Engineering, manufacturing and construction industries
Code and classification of training directions:	8D072 – Manufacturing and processing industries
Group of educational programs:	D116 – Mining and mineral extraction
Level based on NQF:	8 уровень – Postgraduate education (programmes resulting in the academic degree of Doctor of Philosophy (PhD) and doctorates in the field and/or practical experience)
Level based on IQF:	8 уровень – Knowledge at the top level of science and professional practice
Study period:	3 years
Amount of credits:	180

Almaty 2025

Educational program 8D07211- " Digital modelling of mining and geomechanical processes " was approved at the meeting of K.I. Satbayev KazNRTU Academic Council
Minutes № 17 dated «11» July 2024

Was reviewed and recommended for approval at the meeting of K.I. Satbayev KazNRTU Educational and Methodological Council
Minutes № 8 dated «05» July 2024

Educational program 8D07211- " Digital modelling of mining and geomechanical processes " was developed by Academic committee based on direction «Manufacturing and processing industries »

Full name	Academic degree/ academic title	Position	Workplace	Signature
Chairperson of Academic Committee:				
Moldabayev Serik	Doctor of Technical Sciences	Head of the Department	KazNRTU named after K.I.Satpayev	
Teaching staff:				
Yusupov Kh.	Doctor of Technical Sciences	professor	KazNRTU named after K.I.Satpayev	
Sandbekov Manarbek	Candidate of Technical Sciences	professor	KazNRTU named after K.I.Satpayev	
Employers:				
Buktukov Nikolay	Doctor of Technical Sciences	professor	Institute of Mining named after. D. Kunaeva	
Amankulov Maksat	Master of Engineering sciences	Executive Director	Antai LLP	
Orynbayev Baurzhan	Master of Engineering sciences	Head of the BVR parameters department	NPP Interrin LLP	
Gryaznov Vyacheslav	Master of Engineering sciences	Head of the mining Department	Antai LLP	
Students				
Slyambekov Elnar		4th year student OP 6B07205 - Mining engineering	KazNRTU named after K.I.Satpayev	
Shabazz Din-Muhammad		master's student 2 courses	KazNRTU named after K.I.Satpayev	
Asylkhanova Gulnur	Master of Engineering sciences	2nd year doctoral student	KazNRTU named after K.I.Satpayev	

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List of abbreviations and designations

NJSC ‘Kazakh National Research Technical University named after K.I. Satpayev’ - NJSC (non-profit joint stock company) KazNITU named after K.I. Satpayev;
SOSE - State obligatory standard of education of the Republic of Kazakhstan;
MES RK - Ministry of Education and Science of the Republic of Kazakhstan;
EP - educational programme;
IWS - independent work of a student (student, master's student, doctoral student);
IWST - independent work of a student with a teacher (independent work of a student (master's student, doctoral student) with a teacher);
WSP - work study plan;
CED - catalogue of elective disciplines;
UC - university component;
EC - elective component;
NQF - national qualifications framework;
NQF - national qualifications framework; SQF - sectoral qualifications framework;
LO - learning outcomes;
KC - key competences.

1. Description of educational program

The educational programme of doctoral training by profile is aimed at the introduction of the mechanism of training of 'industrial doctor of sciences' together with large industrial companies, has a scientific orientation and assumes fundamental methodological and research training and in-depth study of disciplines in relevant areas of science for the system of higher and postgraduate education and scientific sphere. The educational programme of doctoral training by profile assumes fundamental educational, methodological, research training and in-depth study of disciplines in the relevant areas of science for the branches of national economy, social sphere: economics, business administration. Educational programmes of doctoral studies in the part of professional training are developed on the basis of studying the experience of foreign universities and research centres implementing accredited programmes of doctoral training by profile. The content of the educational programme of the profile doctoral studies is established by the higher education institution independently.

The main criterion for the completion of the educational process of doctoral training in the profile is the mastering by the doctoral student of at least 180 academic credits, including all types of educational and research activities. The duration of doctoral studies is determined by the volume of academic credits mastered. When the established volume of academic credits is mastered and the expected learning outcomes for obtaining the degree of doctor in the profile of the educational programme of doctoral studies are achieved, the educational programme of doctoral studies is considered fully mastered.

The content of the educational programme of doctoral studies consists of:

1) theoretical training, including the study of cycles of basic and specialised disciplines;

2) practical training of doctoral students: various types of practical training, scientific or professional internships;

3) research work, including the performance and defence of a doctoral dissertation on the profile;

4) final certification.

Possibility to choose disciplines from the catalogue of elective disciplines of Satbayev University.

Training of personnel in the profile doctoral studies is carried out on the basis of educational programmes of doctoral studies in the profile direction with a study period of not less than three years.

The content of the OP 'Digital modelling of mining and geomechanical processes' on the basis of the development of a multilevel system of training, fundamental and quality of education, continuity and continuity of education and science, the unity of education, upbringing, research and innovation activities, aimed at maximum satisfaction of consumer demands should provide:

- obtaining a full-fledged and quality professional education in the field of mineral deposits development (MPI), confirmed by the level of knowledge and skills, skills and competences, based on the criteria established by the State General

Education Standard, their assessment, both in content and volume:

- preparation of professional and competitive specialists in the field of development of MPI and creation of new technologies of mining production and production management;
- use of methods for analysing and evaluating the results of experiments.

2. Purpose and objectives of educational program

Purpose of EP:

Training of highly qualified technical specialists of top-level mining companies in digital modelling of mining and geomechanical processes at the interface of geotechnology and geomechanics to solve scientific, technological, economic, social and environmental problems of mining production, endowed with the skills of transition to a green economy, transformation of business processes of planning and design of mining operations with the use of mining and geological information systems and increasing the efficiency of mining companies through redistribution of income within the value chain.

Tasks of EP:

- training of doctors by profile, competitive both domestically and on the international labour market, integration of national doctoral programmes into the global educational space;
- control, analyse and evaluate the actions of subordinates, manage a team of performers, including in emergency situations;
- carry out work to improve production activities, develop projects and programmes for the development of the enterprise (subdivisions of the enterprise);
- analyse the processes of mining, mining and construction production and complexes of used equipment as management objects;
- plan and perform theoretical, experimental and laboratory research, process the results obtained using modern information technologies;
- carry out patent search, study scientific and technical information, domestic and foreign experience on the subject of research;
- develop models of processes and phenomena, assess the reliability of the constructed models using modern methods and means of information analysis;
- carry out technical and economic evaluation of deposits of solid minerals and underground construction objects, efficiency of technological equipment utilisation;
- justify the parameters of a mining enterprise;
- perform calculations of technological processes, productivity of technical means of complex mechanisation of works, throughput capacity of transport systems of mining enterprises, prepare schedules of work organisation and calendar plans of production development;
- justify design solutions to ensure industrial and environmental safety, economic efficiency of production facilities for operational exploration, mining and processing of minerals, construction and operation of underground facilities;
- develop the necessary technical documentation as part of creative teams

and independently;

- independently draw up projects and passports for mining and drilling and blasting operations;
- design enterprises for the extraction and processing of solid minerals, as well as the construction of underground facilities using modern information technologies.

3. Requirements for evaluating the educational program learning outcomes

Persons who have mastered the educational programme of doctoral studies and defended a doctoral dissertation, in case of a positive decision of the dissertation councils of HEI with special status or the Committee for Control in the Sphere of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan according to the results of the conducted expertise, are awarded the degree of Doctor of Philosophy (PhD) or doctor on the profile and are issued a state diploma with an appendix (transcript). Persons who have received the degree of Doctor of PhD, to deepen scientific knowledge, to solve scientific and applied problems on a specialised topic perform a postdoctoral programme or conduct scientific research under the guidance of a leading scientist selected by the university.

Trainees have direct access to the QED, syllabi, syllabuses, which are posted on the university website, and also have the opportunity to familiarise themselves with the presentations of academic disciplines posted on the university website and departments.

The cycle of basic disciplines is the foundation of professional education.

The purpose of the cycle of core disciplines is to provide in-depth theoretical knowledge and practical application of specialised engineering knowledge.

Requirements for key competences of doctoral graduates:

1) have an idea of:

- about the main stages of development and change of paradigms in the evolution of science;
- the subject, outlook and methodological specificity of natural (social, humanitarian, economic) sciences;
- scientific schools of the relevant branch of knowledge, their theoretical and practical developments;
- scientific concepts of world and Kazakhstani science in the relevant field;
- the mechanism of introduction of scientific developments in practical activity;
- norms of interaction in the scientific community;
- about pedagogical and scientific ethics of a scientist-researcher.

2) to know and understand:

- modern trends, directions and regularities of development of domestic science in the conditions of globalisation and internationalisation;
- methodology of scientific cognition;
- achievements of world and Kazakhstani science in the relevant field;

- (realise and accept) social responsibility of science and education;
- perfectly foreign language to carry out scientific communication and international co-operation;

3) be able to:

- organise, plan and implement the process of scientific research;
- analyse, evaluate and compare different theoretical concepts in the field of research and draw conclusions;
- analyse and process information from various sources;
- conduct independent scientific research characterised by academic integrity, based on modern theories and methods of analysis;
- generate their own new scientific ideas, communicate their knowledge and ideas to the scientific community, expanding the boundaries of scientific knowledge;
- select and effectively use modern research methodology;
- plan and predict their further professional development;

4) have the skills to:

- Critically analyse, evaluate and compare different scientific theories and ideas;
- analytical and experimental scientific activity;
- planning and forecasting of research results;
- public speaking and public presentation at international scientific forums, conferences and seminars;
- scientific writing and scientific communication;
- planning, coordinating and implementing research processes;
- a systematic understanding of the field of study and demonstrate the quality and impact of selected scientific methods;
- systematic understanding of the field of study and demonstrate the quality and efficiency of the chosen scientific methods;
- participation in scientific events, fundamental scientific domestic and international projects;
- leadership management and team management;
- responsible and creative attitude to scientific and scientific-pedagogical activities;
- conducting patent searches and experience in communicating scientific information using modern information and innovation technologies;
- protection of intellectual property rights for scientific discoveries and developments;
- free communication in a foreign language;

5) to be competent:

- in the field of scientific and scientific-pedagogical activity in the conditions of rapid updating and growth of information flows;
- in conducting theoretical and experimental scientific research;
- in setting and solving theoretical and applied problems in scientific research;
- professional and comprehensive analysis of problems in the relevant field;
- interpersonal communication and human resource management;
- in matters of university training of specialists;

- Expertise of scientific projects and research;
- ensuring continuous professional development.

Requirements for the NIRD of a student on the Doctor of Philosophy (PhD) programme:

1) correspondence to the main problem of the educational programme of doctoral studies, on which the doctoral dissertation is defended;

2) is topical and contains scientific novelty and practical significance;

3) is based on modern theoretical, methodological and technological achievements of science and practice;

4) is based on modern methods of data processing and interpretation with the use of computer technologies;

5) is carried out using modern methods of scientific research;

6) contains research (methodological, practical) sections on the main defended provisions.

The practice is carried out with the purpose of formation of practical skills of scientific, scientific-pedagogical and professional activity.

The educational programme of doctoral studies includes:

1) pedagogical and research practice - for those studying on the programme of Doctor of Philosophy;

2) industrial practice - for students on the programme of profile doctoral studies.

During the period of pedagogical practice doctoral students, if necessary, are involved in conducting classes in bachelor's and master's programmes.

Research practice of doctoral students is carried out in order to study the latest theoretical, methodological and technological achievements of domestic and foreign science, as well as to strengthen practical skills, application of modern methods of scientific research, processing and interpretation of experimental data in the dissertation research.

Production practice of doctoral students is carried out in order to consolidate the theoretical knowledge obtained in the process of training and to improve professional level.

The content of research and industrial practice is determined by the topic of the doctoral dissertation.

The students follow the programme of practice, keep diaries, observe the rules of labour regulations at the places of practice, study and observe the rules of safety. At the end of the internship provide the internship supervisor with a report on the internship, a written diary and defend the internship report in due time.

4. Passport of educational program

4.1. General information

№	Field name	Comments
1	Code and classification of the field of education	8D07 – Engineering, manufacturing and construction industries
2	Code and classification of training directions	8D072 – Manufacturing and processing industries
3	Educational program group	D116 – Mining and mineral extraction
4	Educational program name	Digital modelling of mining and geomechanical processes
5	Short description of educational program	Training implies serious research work, the fulfilment of which significantly increases the status of the doctoral student as a young scientist in his/her field of study
6	Purpose of EP	Training of highly qualified technical specialists of top-level mining companies in digital modelling of mining and geomechanical processes at the interface of geotechnology and geomechanics to solve scientific, technological, economic, social and environmental problems of mining production, endowed with the skills of transition to a green economy, transformation of business processes of planning and design of mining operations with the use of mining and geological information systems and increasing the efficiency of mining companies through redistribution of income within the value chain.
7	Type of EP	New
8	The level based on NQF	Level 8 - higher education and practical experience
9	The level based on IQF	Level 8 - a wide range of specialised (theoretical and practical) knowledge (including innovative knowledge).
10	Distinctive features of EP	no
11	List of competencies of educational program	1) To work on improvement of production activities, development of projects and programmes for the development of the enterprise (subdivisions of the enterprise) 2) Analyse the processes of mining, mining and construction production and complexes of used equipment as management objects; 3) Plan the performance of theoretical, experimental and laboratory research with the processing of obtained results using modern information technologies; 4) Search for patents, analyse scientific and technical information, domestic and foreign experience on the subject of research; 5) Develop models of processes, phenomena, assess the reliability of the constructed models with the use of modern methods and means of information analysis) 6) Prepare technical and economic evaluation of deposits of solid minerals and underground construction objects, efficiency of technological equipment usage;

		7) Calculate technological processes, productivity of technical means of complex mechanisation of works, throughput capacity of transport systems of mining enterprises, propose schedules of work organisation and calendar plans of production development; 8) Evaluate design solutions to ensure industrial and environmental safety, economic efficiency of production facilities for operational exploration, mining and processing of minerals, construction and operation of underground facilities; 9) Design enterprises for the extraction and processing of solid minerals, as well as the construction of underground facilities using modern information technologies; 10) Plan the parameters of the mining enterprise development
12	Learning outcomes of educational program	Defence of a doctoral thesis by a doctoral student after completion of studies in the profile doctoral programme 'Digital Modelling of Mining and Geomechanical Processes'.
13	Education form	Full-time
14	Period of training	3 years
15	Amount of credits	180
16	Languages of instruction	Kazakh/Russian
17	Academic degree awarded	doctor by profile
18	Developer(s) and authors	Academic commit

4.2 Relationship between the achievability of the formed learning outcomes based on educational program and academic disciplines

№	Discipline name	Short description of discipline	Amount of credits	Generated learning outcomes (codes)									
				LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9	L10
Cycle of general education disciplines													
1	Academic writing	The course aims to develop academic writing skills and writing strategies in doctoral students in engineering and science. The course focuses on the fundamentals and general principles of academic writing for; writing effective sentences and paragraphs; using tenses in academic writing, as well as styles and punctuation; writing an abstract, introduction, conclusion, discussion, conclusion, literature used, and resources; citation in the text; avoiding plagiarism; and composing a conference presentation	5		X	X	X	X	X		X		
2	Scientific research methods	The course contributes to the formation of knowledge about scientific research, methods and methodology of scientific research, methods of collection, processing of scientific data, principles of organisation of scientific research, methodological features of modern science, ways of development of science and scientific research, the role of technical sciences, informatics and engineering research in modern science. The discipline deals with the structure of technical sciences, application of general scientific, philosophical and special methods of scientific research in theory and practice	5		X	X	X	X	X				X
Required component													
3	Environmentally friendly technologies in open-pit mining operations	The course familiarises with the best practices and international experience in the context of implementation of green technologies in open pit mining. Content: solving the transport problem of deep open pits in connection with the reduction of their sides and emissions into the environment; ensuring the minimum size of concentration horizons when switching to combined modes of transport; maintaining high production capacity of open pits to great depths with the use of innovative designs of steeply inclined lifts	5		X	X	X		X		X	X	X
4	Establishment of the spatial position of pit contours in the dynamics of mining operations development	The course is aimed at establishing the optimal positions of current and final contours of deep pits on the basis of digital models of deposits. Content: preparation of volumetric geological model of the deposit; justification of the parameters determining the optimal volumetric location of the current and final contours of the open pit, the method of calculating their parameters; method of establishing the volumetric current and final contours of the open pit on a new methodological basis; establishment of step-by-step contours of the investigated open pit on the basis of a new method of optimising the current and final contours of the open pit	5		X	X	X	X	X	X	X	X	X

5	Level of balanced development of vertically integrated mining companies	The course aims to reveal the aspects of improving the efficiency of mining companies within the framework of vertical integration through the redistribution of income within the value chain. Content: sectoral and microeconomic support of balanced use of strategic advantages of business segments of vertically integrated mining companies (VIMC); determination of the level of balanced development of the company's strategic advantages; the essence of the methodology for determining the balanced development index of VIMC and the feasibility of its use for the integral assessment of the efficiency improvement programme of VIMC and its business segments	5		X	X	X		X	X	X	X	X
6	Science of sustainable development	On course, sound environmental and development management policies must be science-based, with a range of alternatives always available to ensure flexible responses, improve understanding of the world and foster interaction between science and society. In the face of the threat of irreversible environmental catastrophe, the lack of adequate scientific evidence should not be an excuse for postponing measures that are justified. A precautionary approach could serve as a basis for the formulation of policies related to complex systems that are not yet fully understood and whose consequences of disruption cannot yet be predicted	5		X	X	X	X	X	X	X	X	X
Cycle of specialised disciplines M-2. Module of specialised training (elective component)													
7	Innovative technologies of underground development of low thickness ore deposits	The course mastering of advanced technologies of underground development of shallow ore deposits in the zone of geological disturbances. Content: stripping, development and basic processes of underground mining of deposits; modern technologies used in conditions of great depths; occurrences of rock pressure in dynamic form; assessment of the stressed state of the massif and determination of safe parameters of development systems in bump hazardous massifs of a number of known deposits; innovative methods of underground development of thin ore deposits	5		X	X	X	X	X	X	X	X	X
8	Probabilistic-statistical modelling of geomechanical processes	Course to study the methodology of creating predictive models of rock behaviour under conditions of uncertainty of initial data. Content: processing of statistical data on the state of rock massif, experiment planning, construction of probabilistic models of rock strength and fracture, introduction of stochastic component in the strength criteria (Hock-Brown, Coulomb-Mohr, Parchevsky-Shashenko), Monte Carlo simulation modelling	5			X	X	X	X	X	X	X	X
9	Development of information complexes in planning and design of mining operations	The course is aimed at obtaining skills in the process of implementation of the project of transformation of business processes of planning of mining operations with the use of mining and geological information system. Content: analysis of the use of integrated systems and complexes of geo-information orientation in mining; strategic planning of open pit mining; optimisation of the mining sequence, selection of cut-off grades, the amount of mining equipment required and capital expenditure to maximise the net discounted income of the project or to achieve corporate goals	5	X	X	X			X	X	X	X	X
10	Physicochemical geotechnology	The course is aimed at the study of physicochemical geotechnology as a science, consistently revealing the stages of its formation, various methods of processing of	5			X	X	X	X		X		

		certain natural resources in the Earth's subsoil and physical and geological factors determining the efficiency of deposit development in an innovative way											
11	Projecting of combining development of mineral deposits	The course is aimed at mastering the design skills in the transition from open-pit to underground mining of mineral deposits, especially the establishment of parameters of the open-underground layer, which determines the efficiency of safe transition to the underground method with the construction of underground workings. At the same time, geomechanical justification of the limiting height of the open-underground layer and the thickness of the remaining pillar between the open and underground workings serve as the basis for the expedient application of the combined method of development of deep-lying deposits	5	X	X	X			X	X	X	X	X
12	Numerical modelling of spatial and temporal processes in rock massifs	The course will cover numerical methods for determining the stress-strain state of rock massifs and assessing the stability of rock exposures. Content: three-dimensional stress state of the rock mass, deformation models of the medium, finite element method (FEM), implementation of FEM in RS3 Rocscience software, modelling of underground mine workings stability, modelling of pit wall stability, modelling of mining development in time	5	X	X	X			X	X	X	X	X

5 Curriculum of the educational program

KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I.SATPAYEV

SATBAYEV UNIVERSITY

APPROVED
Chairman of the Management Board-
Rector of KazNRTU named after K.Satpayev
M.M. Begentaev
«__» ____ 2024 y.

CURRICULUM
of Educational Program on enrollment for 2024-2025 academic year

Educational program 8D07211- "Digital modeling of mining and geomechanical processes"
Group of educational programs D116 - "Mining Engineering"

Form of study: full-time **Duration of study: 3 year** **Academic degree: Doctor by profile**

Discipline code	Name of disciplines	Cycle	Total amount in credits	Total hours	Classroom amount lec/lab/pr	SIS (including TSIS) in hours	Form of control	Allocation of face-to-face training based on courses and					
								I course		2 course			
								1 semester	2 semester	3 semester	4 semester	5 semester	6 semester
CYCLE OF BASIC DISCIPLINES (BD)													
M-1. Module of basic training (university component)													
MET322	Scientific research methods	BD UC	5	150	2/0/1	105	E	5					
LNG305	Academic writing	BD UC	5	150	0/0/3	105	E	5					
component of choice													
MIN327	Environmentally friendly technologies in open-pit mining	BD CCHBD CCH	5	150	2/0/1	105	E	5					
MIN328	Establishing the spatial position of quarry contours in the dynamics of mining development												
MIN329	Level of balanced development of vertically integrated mining companies												
MNG350	Sustainability Science												
CYCLE OF PROFILE DISCIPLINES (PD)													
M-2. Module of professional activity (component of choice)													
MIN330	Innovative technologies for underground development of thin ore deposits	PD, CCH	5	150	2/0/1	105	E	5					
MIN325	Probabilistic-statistical modeling of geomechanical												
MIN331	Development of information systems for planning and designing mining operations												
MIN317	Physico-chemical geotechnology	PD, CCH	5	150	2/0/1	105	E	5					
MIN320	Designing the combined development of mineral deposits												
MIN326	Numerical modeling of spatiotemporal processes in rock mass												

M-3. Practice-oriented module													
AAP371	Industrial intership	PD UC	20						20				
M-4. Experimental research module													
AAP372	Experimental research work of doctoral student, including internships and doctoral dissertations	ERWDS UC	5					5					
AAP376	Experimental research work of doctoral student, including internships and doctoral dissertations	ERWDS UC	10						10				
AAP374	Experimental research work of doctoral student, including internships and doctoral dissertations	ERWDS UC	90							30	30	30	
AAP375	Experimental research work of doctoral student, including internships and doctoral dissertations	ERWDS UC	18										18
M-5. Module of final attestation													
ECA303	Writing and defending a doctoral dissertation	FA	12										12
Total based on UNIVERSITY:								30	30	30	30	30	30
								60		**60**		**60**	

Number of credits for the entire period of study					
Cycle code	**Cycles of disciplines**	**Credits**			
			university component (UC)	**component of choice (CCH)**	**Total**
BD	Cycle of basic disciplines		10	5	15
PD	Cycle of profile disciplines		20	10	30
	Total for theoretical	***0***	***30***	***15***	***45***
	ERWDS				***123***
FA	Final attestation	12			12
	TOTAL:	**12**	**30**	**15**	**180**

Decision of the Academic Council of KazNRTU named after K.Satpayev. Protocol № 12 **от "** 11 **"** 07 **20** 24 **y.**

Decision of the Educational and Methodological Council of KazNRTU named after K.Satpayev. Protocol № 8 **от "** 05 **"** 07 **20** 24 **y.**

Decision of the Academic Council of the Mining and Metallurgical Institute. Protocol № 9 **от "** 09 **"** 05 **20** 24 **y.**

Vice-Rector for Academic — **R.Uskenbayeva**

Director of the Institute of — **K. Rysbekov**

Head of the Department — **S. Moldabayev**

Council representative from — **B. Bakhramov**