Mining and Metallurgical Institute named after O.A. Baikonurov

Mining Department

EDUCATIONAL PROGRAM
7M07230 – "Mining Resource-saving Digital Engineering"

Code and classification of the field of education:	7M07 – Engineering, Manufacturing and Construction industries
Code and classification of training directions:	7M072 – Manufacturing and Processing industries
Group of educational programs:	M116 – Mining
Level based on NQF:	Level 7 – higher education and practical experience
Level based on IQF:	Level 7 – A wide range of special (theoretical and practical) knowledge (including innovative knowledge). Independent search, analysis and evaluation of professional information
Study period:	1 year
Amount of credits:	60

Almaty 2024

Educational program 7M07230 – "Mining Resource-saving Digital Engineering" was approved at the meeting of K.I. Satbayev KazNRTU Academic Council. Minutes № 17 dated 11 July 2024.

Educational program 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 7M07230 – "Mining Resource-saving Digital Engineering" was developed by Academic committee based on direction « Manufacturing and processing industries »

Full name	Academic degree/academic title	Post	Place of work	Signature
Chatiman of the Academic Committee:				
Moldabayev Serik	Doctor of Technical Sciences, Professor	Head of the Department	KazNRTU named after K.I. Satpayev	
Teaching staff:				
Yusupov Kh.	Doctor of Technical Sciences, Professor	Professor	KazNRTU named after K.I. Satpayev	
Sandibekov Manarbek	Candidate of Technical Sciences, Associate Professor	Professor	KazNRTU named after K.I. Satpayev	
Employers:				
Amankulov Maksat		Executive Director	Antal LLP	
Orynbayev Baurzhan		Head of the BVR Parameters Department	NPP Interrin LLP	
Students:				
Assylkhanova Gulnur		2nd year doctoral student		
Assylkhanova Samal		1st year doctoral student		
Kakim Batyrbek		1st year Master 's student		
Ragyt Akmonshak		4th year student		
Oskenbayev Adilet		4th year student		

Table of contents

List of abbreviations and designations

NAO "Kazakh National Research Technical University named after K.I. Satpayev" – NAO KazNRTU named after K.I. Satpayev;

GOSO – The State mandatory standard of education of the Republic of Kazakhstan**;**

MNVO RK – Ministry of Science and Higher Education of the Republic of Kazakhstan**;**

OP – educational program;

SRO – independent work of a student (student, master's student, doctoral student);

SROP – independent work of a student with a teacher (independent work of a student (undergraduate, doctoral student) with a teacher);

RUP – a working curriculum;

QED – catalog of elective disciplines;

VK – university component;

KV – component of choice;

NRK – National Qualifications framework;

ORC – Industry qualifications framework;

RO – learning outcomes;

CC – key competencies.

1. Description of educational program

It is intended for the implementation of specialized bachelor's degree training in the educational program 7M07230 - "Mining resource-saving digital Engineering" at Satbayev University and was developed within the framework of the direction "Manufacturing and processing industries".

This document meets the requirements of the following legislative acts of the Republic of Kazakhstan and regulatory documents of the Ministry of Education and Science of the Republic of Kazakhstan:

– The Law of the Republic of Kazakhstan "On Education" with amendments and additions in the framework of legislative amendments to enhance the independence and autonomy of universities dated 04.07.18 №171-VI;

– The Law of the Republic of Kazakhstan "On Amendments and Additions to Certain Legislative Acts of the Republic of Kazakhstan on the expansion of academic and managerial independence of higher education institutions" dated 07/04/18, No. 171-VI;

– Order of the Minister of Education and Science of the Republic of Kazakhstan dated 10/30/18, No. 595 "On approval of Standard Rules for the activities of educational organizations of appropriate types";

– The State mandatory standard of higher education (Appendix 7 to the Order of the Minister of Education and Science of the Republic of Kazakhstan dated 31.10.18 №604;

– Resolution of the Government of the Republic of Kazakhstan dated December 27, 2019 No. 988 "On approval of the State Program for the Development of Education and Science of the Republic of Kazakhstan for 2020-2025";

– Resolution of the Government of the Republic of Kazakhstan dated 31.12.2019 No. 1050 "On approval of the State Program of Industrial and Innovative Development of the Republic of Kazakhstan for 2020-2025";

– "National Qualifications Framework", approved by the protocol dated 16.06.2016. By the Republican Tripartite Commission on Social Partnership and Regulation of Social and Labor Relations;

– Industry Qualifications Framework "Mining and Metallurgical Complex" dated 30.07.2019 No. 1;

The educational program 7M07203 - "Mining Engineering" takes into account the field of professional activity of graduates who have completed the bachelor's degree program and includes:

– the bowels of the Earth, including production facilities, equipment and technical systems for their development;

– measures to ensure the safe operation of mining machinery and equipment and reduce their anthropogenic impact on the environment.

Types and objectives of the graduate's professional activity

The list of types of professional activity and their corresponding professional tasks:

Organizational and managerial:

- organization, planning and management of mining and construction works;

- carrying out organizational and planning calculations for the creation (reorganization) of production sites;

- development of operational work plans for production units;

Production and technological:

- organization of the production process during the construction, operation and reconstruction of mining enterprises, various facilities on the surface and underground;

- ensuring the performance of mining and construction works in accordance with projects, technical requirements and safety regulations;

- selection of equipment and materials to support production processes;

The subjects of the bachelor's professional activity are the improvement of mining technology, the development and creation of new mining equipment and technology, taking into account the needs of the mining and nuclear industry of the Republic of Kazakhstan.

The specific types of professional activities for which the bachelor is mainly preparing are determined by the higher education institution together with students, scientific and pedagogical staff of the higher educational institution and employers' associations.

2. Purpose and objectives of educational program

The purpose of EP 7M07230 – "Mining resource-saving digital engineering" are: to train highly qualified specialists in the field of solid mineral development, meeting the requirements of modern high-tech resource-saving production, capable of high-tech production and design of mining operations using digital information systems and endowed with the skills of transition to a green economy.

Graduates of EP will be able to: acquire skills in implementing resource-saving, environmentally friendly mining technologies; apply licensed software products to create working drawings with optimal mining conditions; perform theoretical and experimental laboratory studies with the processing of the results obtained using modern information technologies.

The tasks of EP 7M07230 – "Mining resource-saving digital engineering" are:

- study of a cycle of general education disciplines to provide social and humanitarian education based on the laws of socio-economic development of society, history, modern information technologies, the state language, foreign and Russian languages;

- the cycle of core disciplines focuses on the study of key theoretical aspects of engineering and technology to ensure the safe and effective implementation of various technologies for the extraction, processing of solid minerals and the rational use of natural resources;

- study of disciplines on the development of uranium deposits, extraction of natural resources by open and underground methods based on advanced technologies, planning the construction of industrial facilities at mining enterprises and urban underground structures for various purposes;

- study of disciplines that form knowledge, skills and abilities in planning and

organizing research and mining design;

- familiarization with the technologies and equipment of enterprises during the period of various types of practices;

- acquisition of skills in laboratory research, technological calculations, equipment selection and design using modern computer technologies and programs.

– combining the efforts of the University and manufacturing enterprises to conduct scientific research, train and retrain personnel in the field of studying the principles and patterns of functioning and development of cities and megacities, the features of anthropogenic impacts on urban objects, the principles of sustainable development of urbanized territories and measures of their organizational and legal support, ensuring true interdisciplinarity of education in these areas;

– formation of skills and abilities in choosing and evaluating methods of environmental protection from anthropogenic impact in urbanized areas;

– strengthening the technological component of classical natural science education, to provide knowledge on modern technologies without lowering the bar for the level of fundamental education;

– fundamentals of the development and conduct of fundamental and applied research and development in the field of geological exploration and mineral processing, mining and metallurgy using new technological achievements, new generation equipment and environmental monitoring of enterprises;

– ensuring the interaction of fundamental and applied science with the educational process at all its stages, including the use of the results of joint research in lecture courses, an experimental base for conducting educational research, laboratory and term work, industrial and postgraduate practice;

– improving the level of educational and methodological work by creating new curricula, textbooks, educational and methodological manuals, including on electronic media;

– provision of training and retraining of personnel for the domestic mining and metallurgical sector in close cooperation with state corporations and the real sector of the economy, employment of graduates in high-tech innovative companies and other research centers;

– organization of effective cooperation with foreign universities for the development of new generation educational standards, student exchange, training and retraining of mining and metallurgical industry specialists in specialized bachelor's degree programs;

– implementation of international cooperation in the field of development of new technologies in the mining and metallurgical industry through the implementation of joint contracts, participation in international conferences, organization of international exchange of staff, students and young scientists with relevant universities and laboratories of the world, international scientific and educational organizations;

– formation of theoretical and practical knowledge in technologies for processing man-made and secondary raw materials, knowledge in technologies for the production of ferrous and non-ferrous metals, as well as their alloys and various metal-containing products from man-made materials and secondary resources.

– formation of theoretical and practical knowledge in the field of processing critical raw materials and metals, innovative "green" technologies of the metallurgical sector, waste disposal of metallurgical production and environmental restoration.

3. Requirements for evaluating the educational program learning outcomes

The graduate of this educational program is awarded the academic degree "Master of Technical Sciences" in the direction 7M07230 - Manufacturing and processing industries (Mining resource-saving digital engineering).

A graduate who has completed Master's degree programs must have the following general professional competencies:

– the ability to independently acquire, comprehend, structure and use new knowledge and skills in professional activities, to develop their innovative abilities;

– the ability to independently formulate research goals, establish the sequence of solving professional tasks;

– the ability to apply in practice the knowledge of fundamental and applied sections of disciplines that determine the focus (profile) of the master's degree program;

– the ability to professionally select and creatively use modern scientific and technical equipment to solve scientific and practical problems;

– the ability to critically analyze, present, defend, discuss and disseminate the results of their professional activities;

– proficiency in the preparation and execution of scientific and technical documentation, scientific reports, reviews, reports and articles;

– willingness to lead a team in the field of their professional activities, tolerant of social, ethnic, religious and cultural differences;

– willingness to communicate orally and in writing in a foreign language to solve the tasks of professional activity.

A graduate who has completed a master's degree program must possess professional competencies corresponding to the types of professional activities that the Master's degree program is focused on:

scientific and production activities:

– the ability to independently carry out production and scientific field, laboratory and interpretive work in solving practical problems;

– the ability to professionally operate modern field and laboratory equipment and devices in the field of the master's degree program;

– the ability to use modern methods of processing and interpreting complex information to solve production problems;

– *project activities:*

– the ability to independently draw up and submit projects of scientific research and scientific production works;

– willingness to design complex scientific research and scientific production works in solving professional tasks;

– *organizational and managerial activities:*

– willingness to use practical skills in organizing and managing research and scientific production work in solving professional tasks;

– readiness for the practical use of regulatory documents in the planning and organization of scientific and production work;

4. Passport of educational program

4.1. General information

№	Field name	Comments
1	Code and classification of the field of education	7M07 – Engineering, Manufacturing and Construction industries
2	Code and classification of training directions	7M072 – Manufacturing and Processing industries
3	Educational program group	M116 – Mining and Mining

4	Educational program name	Mining resource-saving digital engineering
5	Short description of educational program	Mining operations in open-pit, underground and geotechnological mining, construction of mines and underground structures. The main technological processes are preparation of rocks for excavation, excavation and loading operations, transportation, unloading and dumping operations, primary processing of extracted minerals.
6	Purpose of EP	The purpose of the educational program is to train highly qualified specialists in the field of solid mineral mining, meeting the requirements of modern high-tech resource-saving production, capable of high-tech production and design of mining operations using digital information systems and equipped with the skills to transition to a green economy.
7	Type of EP	New
8	The level based on NQF	Level 7 – higher education and practical experience
9	The level based on IQF	Level 7 – a wide range of special (theoretical and practical) knowledge (including innovative knowledge).
10	Distinctive features of EP	The innovative OP was prepared on the basis of the developed innovative resource-saving technologies at the Mining Department
11	List of competencies of educational program	Skills in implementing resource-saving, environmentally friendly mining technologies. Be able to use licensed software products to create working drawings with optimal mining conditions. To carry out theoretical and experimental laboratory studies with the processing of the obtained results using modern information technologies.
12	Learning outcomes of educational program	1. Provide technical guidance for mining and blasting operations, as well as work to ensure the functioning of mining equipment and technical systems. 2. To develop regulatory documents regulating the procedure for mining and blasting operations, as well as work related to the primary processing of solid minerals, the construction and operation of underground structures, to comply with the requirements of technical documentation for the work, applicable norms, rules and standards. 3. Prepare and propose measures to improve the environmental safety of mining. 4. To calculate technological processes, productivity of technical means of complex mechanization of work, capacity of transport systems of mining enterprises, to build schedules of work organization and calendar plans of production development. 6. To prepare and propose measures to improve and enhance the technical level of mining production, to ensure the competitiveness of the organization in modern economic conditions. 7. Write management texts; propose various business situations in discussions, meetings and negotiations; contrast written and oral speech in English on management-related topics. 8. Choose the use of modern information technologies

		and automated production management systems to create SMART mines.
13	Education form	Full-time full-time
14	Period of training	1 year
15	Amount of credits	60
16	Languages of instruction	Kazakh/Russian
17	Academic degree awarded	Master of Technical Sciences
18	Developer(s) and authors	Moldabayev S.K.

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)								
				PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9
Cycle of basic disciplines M-1. Cycle of basic disciplines. University component												
1	Foreign language	The course is designed for undergraduates of technical specialties to improve and develop foreign language communication skills in the professional and academic fields. The course introduces students to the general principles of professional and academic intercultural oral and written communication using modern pedagogical technologies (round tables, debates, discussions, analysis of professionally oriented cases, design). The course ends with a final exam. Undergraduates also need to study independently (MIS)	2			X						
2	Management	The main goal of management is to ensure the efficient use of resources: finance, technology, people, and time. The management course focuses on important skills such as communication, problem solving, decision making, and leadership. These skills can be transferred and applied in various industries. Whether you work in finance, healthcare, technology, or manufacturing, management skills are of universal importance.	2									
3	Psychology of management	The purpose of the discipline is to familiarize students with modern concepts of the role and multidimensional content of the psychological component of managerial activity; to enhance the psychological culture of the future master for the successful implementation of professional activities and self-improvement. Studies the main stages, trends and trends in the development of Kazakh and foreign management psychology, the composition and structure of management activities. Special attention is paid to the psychological component of the managerial function, the individual characteristics of the manager, the ethical and cultural components of the head, the basics of interaction.	2							X	X	

Component of choice The module of digitalization in mining												
	Geomechanical research in open-pit mining	The aim is to study the geomechanical processes characteristic of open-pit mining of ore and coal deposits. The main problems of geomechanics that arise during the design and open-pit mining of mineral deposits related to the prediction of deformations of sides, benches and dumps in quarries in various geological and engineering-geological conditions. Deformations of open pit slopes with an analysis of the causes of their occurrence and patterns of development, methods for predicting the mechanism of destruction of the massif. Optimal slope parameters and examples of designing sides of rational profiles. Numerical modeling of geomechanical processes on generalized and sectoral models using the example of the ultra-deep Kachar open pit mine.	4									
	Geomechanical research in underground mining	The aim is to study the geomechanical processes characteristic of underground mining of ore deposits. The course includes determining the size of permissible roof exposures of cleaning spaces, the size of stable inter-chamber pillars; general principles for calculating the size of support pillars, determining the size of support pillars; the impact of explosions on the stability of inter-chamber pillars, the effect of laying chambers on the stability of inter-chamber pillars; determining the thickness of ceiling pillars, the formation and development of a collapse zone; calculating the stable dimensions of cantilever rock; stress-strain zones of rocks around the treatment workings; collapse craters; rock displacement during underground mining of ore deposits. Examples of studying the natural stress field for the completeness of ore reserves extraction at great depths.	4									
Cycle of profile disciplines M-2. Specialized training module (optional component) Mining Production Support Module												
	Underground mine design	The course is aimed at instilling computer-aided design skills for underground mines during their design and operation using integrated mining and geological information systems, including working with database files, creating and analyzing points, strings, frames, digital surface models and block models, and drawing underground workings.	5		X			X				

	Methodology of designing the construction of underground structures	The course covers a set of methods for designing the construction of underground structures in mining, technological, mining, financial, economic, occupational safety and safety, taking into account the peculiarities of the mining and geological conditions of the rock mass, conducting the necessary scientific research	5		X	X		X				
	Technology for the construction of underground metro facilities	The course is aimed at instilling skills in the selection and calculation of underground subway structures based on the study of methods for fixing underground structures and sinking construction shafts, the preparatory period of construction, technology and organization of the construction of approach and inclined workings, distillation tunnels using mining shields, technological schemes for the construction of subway stations, including three-arched	5		X	X		X	X			X
	Modernization of horizontal and inclined mining operations	The course is aimed at studying advanced technologies for horizontal and inclined mining based on the improvement of basic technological processes, the practice of sinking workings using selective and drilling combines, technology for the construction of inclined workings from top to bottom and vice versa, from bottom to top.	5		X			X		X		
Mining Production Module												
	Highly rhythmic safe mining operations in deep quarries	The course introduces the theory and practice of implementing advanced technologies in the open-pit mining of mineral deposits to great depths with an in-depth study of the method of mining in steeply inclined layers in elongated and rounded open pit fields., the method of automated establishment of optimal calendar volumes of mining operations when mining benches of rock overburden and ore from top to bottom with transverse panels in adjacent steep-sloping layers and a set of studies on the completeness of safe extraction of near-contour and deep reserves based on optimization of the final contours of the open pit mine and the use of innovative technological complexes in the area of cleaning-up of deep open pit mines	5		X	X	X	X				X
	Intensification of reclamation of lands disturbed by open-pit mining	The course is aimed at studying methods of restoring the fertile soil layer and measures to protect the environment based on provisions on the use of natural resources with limited anthropogenic impact on the environment, scientific aspects of mining and biological reclamation and includes a range of studies on the restoration of saline lands.	5	X	X	X		X				X
	The technology of laying the mined	The course is aimed at studying the latest achievements in	5		X	X		X	X			X

	space	the application of development systems with the laying of the developed space, covering the processes of preparation and methods of transportation of the laying mixture with the technology of its placement at the boundary of the treatment excavation. Special attention is paid to reducing the cost of preparing the filling mixture in the process of improving their characteristics: hydraulic, pneumatic, hardening, gravity and mechanical.										
	Rational technologies for the development of placer deposits	The course is aimed at exploring ways to increase the efficiency of the development of placer deposits by open, underwater and underground methods. Based on the results of scientific research and the main provisions on placer mining, examples of gold extraction at the junction of geology, geotechnology and mineral processing are presented.	4		X	X	X	X				X
	Resource-saving clean technologies in open-pit mining	The pursuit of clean technologies of the future is strongly linked to the concept of economic security, diversification and includes a path from a green agenda to a green economy through the development and implementation of particularly advanced progressive technologies in open-pit mining. At the know-how level, students will get acquainted with inventions and design documentation for technological lines for steep lifting of rock mass from deep horizons of quarries without reducing productivity and repeatedly reducing environmental pollution. Prerequisites for the transition to clean technologies include an analysis of the difficulties of implementing in-line and cyclic-flow technologies, increasing the steering angle of the opening workings when using heavy-duty dump trucks at the current stage of open-pit mining.										

5. Curriculum of educational program

MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN
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 7M07230 - "Mining resource-saving digital engineering"
Group of educational programs M116 - "Mining Engineering"

Form of study: full-time **Duration of study: 1 year** **Academic degree: Master of Engineering and Technology (profile direction)**

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 semesters	
								Icourse	
								1 semester	2 semester
CYCLE OF BASIC DISCIPLINES (BD)									
M-1. Module of basic training (university component)									
LNG212	English (professional)	BD, UC	2	60	0/0/2	30	E	2	
MNG726	Management	BD, UC	2	60	1/0/1	30	E	2	
HUM211	Management Psychology	BD, UC	2	60	1/0/1	30	E	2	
Component of choice									
Digitalization module in mining									
MIN703	Geomechanical research on open-pit mining	BD, CCH	4	4	120	1/1/1	75	4	
MIN702	Geomechanical research on underground mining								
CYCLE OF PROFILE DISCIPLINES (PD)									
M-2. Module of professional activity (component of choice)									
Mining Production Support Module									
MIN273	Design of underground mines	PD, CCH	5	150	2/0/1	105	E	5	
MIN211	Methodology of designing of underground construction								
MIN253	Technology of construction of metropolitan	PD, CCH	5	150	2/0/1	105	E	5	
MIN285	Modernization of the processes of horizontal and inclined mine workings								
Mining Production module									
MIN700	Highly rhythmic safe production of mining operations in deep quarries	PD, CCH	5	150	2/0/1	105	E	5	
MIN701	Intensification of reclamation of lands disturbed by open mining operations								
MIN295	Technology of laying-of the develped space	PD, CCH	5	150	2/0/1	105	E	5	
MIN296	Rational technologies for development of placer deposits								
MIN713	Resource-saving clean technologies in open-pit mining	PD, CCH	4	120	2/0/1	75	E		4
M-3. Practice-oriented module									
AAP253	Production practice	PD, CCH	5						5
M-4.Experimental research module									
AAP257	Experimental research work of a master's student, including internship and implementation of a master's project	ERWM UC	13						13
M-5. Module of final attestation									
ECA213	Registration and protection of the master's project (RaPMP)	FA	8						8
	Total based on UNIVERSITY:							30	30
								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		6	4	10
PD	Cycle of profile disciplines				29
	Total for theoretical training:	*0*	*6*	*4*	*39*
	ERWM				*13*
FA	Final attestation	8			8
	TOTAL:	**8**	**6**	**4**	**60**

Decision of the Academic Council of KazNRTU named after K.Satpayev. Protocol №12 от "11" 07 2024 y.

Decision of the Educational and Methodological Council of KazNRTU named after K.Satpayev. Protocol №8 от "09" 07 2024 y.

Decision of the Academic Council of the Mining and Metallurgical Institute. Protocol № 9 от "09" 05 2024 y.

Vice-Rector for Academic Affairs	R.Uskenbayeva
Director of the Institute of Mining and Metallurgical	K. Rysbekov
Head of the Department "Mining"	S. Moldabayev
Council representative from employers	B. Bakhramov

6. Additional educational programs (Minor)

Name of additional educational programs (Minor) with disciplines	Total number of credits	Recommended semesters of study	Documents on the results of mastering the additional educational programs (Minor)