



Mining and Metallurgical Institute named after O.A. Baikonurov
Department of «Metallurgy and Mineral Processing»

TWO-DEGREE EDUCATIONAL PROGRAM

7M07226 – Mineral processing

Code and classification of the field of education:	7M07 – Engineering, manufacturing and construction industries
Code and classification of training areas:	7M072 – Manufacturing and processing industries
Group of educational programs:	M118 – Mineral processing
The level of the NRK:	7
ORC Level:	7
Duration of training:	2 years
Volume of loans:	120

Almaty 2025

Two – degree educational program «7M07226 – Mineral processing» was approved at the meeting of K.I. Satbayev KazNRTU Academic Council

Protocol № 4 dated « 12 » 12 2024 y.

was reviewed and recommended for approval at the meeting of K.I. Satbayev KazNRTU Educational and Methodological Council

Protocol № 3 dated « 20 » 12 2024 y.

Two-degree educational program «7M07226 – Mineral processing» was developed by Academic committee based on direction of «7M072 – Manufacturing and processing industries»

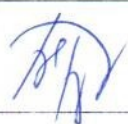
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Table of contents

- List of abbreviations and designations
- 1 Description of the educational program
- 2 The purpose and objectives of the educational program
- 3 Requirements for evaluating the learning outcomes of an educational program
- 4 Passport of the educational program
 - 4.1 General information
 - 4.2 The relationship between the achievability of the formed learning outcomes according to the educational program and academic disciplines
- 5 Curriculum of the educational program

List of abbreviations and designations

NJSC «Kazakh National Research Technical University named after K.I.Satpayev» – NJSC KazNITU named after K.I.Satpayev;

SES – The State compulsory standard of education of the Republic of Kazakhstan;

MSaHE RK - Ministry of Science and Higher Education of the Republic of Kazakhstan;

OP – educational program;

SRO – independent work of a student (student, undergraduate, doctoral student);

SROP – independent work of the student with the teacher (independent work of the student (master's student, doctoral student) with the teacher);

RUP – working curriculum;

CAD – 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;

SDG – Sustainable Development Goals.

1. Description of the educational program

Introduction to the educational program. The development of an innovative economy initially forms the so-called double helices of interaction - between universities (science) and business, business and government, etc., which then form a "triple spiral". Within the framework of the triple helix model, interdisciplinary knowledge is generated, developed by interdisciplinary teams united for a short time to work on a specific problem of the real world. In the triple helix model, universities, along with educational and research functions, additionally increase entrepreneurial functions by actively participating in the cultivation of startups together with industry, stimulated by the state.

The concept of this scientific and educational program is based on *the triple helix model*, which involves the creation of innovative solutions based on interdisciplinary research and educational programs (Figure 1).

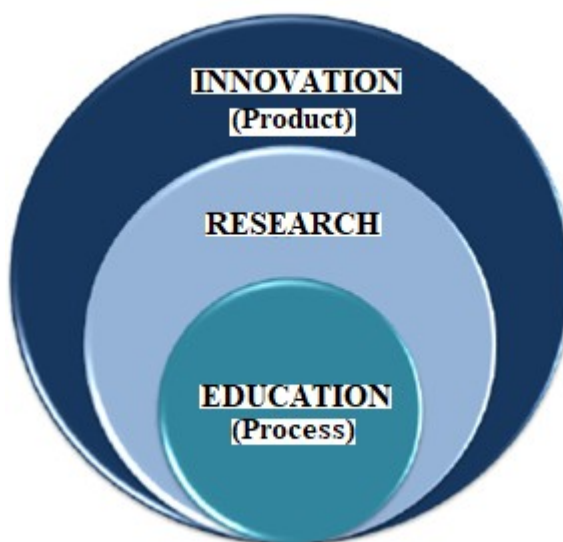


Figure 1 - The concept of scientific and educational programs

The previously established structure of education, based on deep training of specialists in narrowly focused specialization, has led to the emergence of interdisciplinary barriers and hindering the development of new "growth points" that are located at the junctions of disciplines.

Modern needs require graduates not only to have in-depth knowledge in their chosen field of science, but also to understand the mechanisms and tools for implementing their ideas in practice.

The program corresponds to the unified state policy of long-term socio-economic development of the country, training of highly qualified personnel based on the achievements of science and technology, effective use of domestic scientific, technological and human resources potential of the republic.

The program is comprehensive and knowledge-intensive. The efficiency of using its results is of strategic importance for the republic.

The program is aimed at training specialists in key areas of the mining and processing industry, adapted to activities in high-tech sectors of the economy of

the Republic of Kazakhstan on the basis of the development of priority areas of science and technology, the development of high-tech industries, competitive technologies in the processing of man-made raw materials and waste.

The developed Program is the basis of a coherent and flexible system of training advanced scientific and innovative personnel, combining deep fundamental knowledge with a broad scientific outlook and the ability to independently conduct research with a comprehensive understanding of the main problems in the mining and processing industry.

The duration of the master's degree is determined by the amount of academic credits mastered. Upon mastering the established amount of academic credits and achieving the expected learning outcomes for obtaining a master's degree, the Master's degree program is considered fully mastered. The scientific and pedagogical Master's degree program provides 120 academic credits for the entire period of study, including all types of educational and scientific activities of a graduate student.

Planning of the content of education, the way of organizing and conducting the educational process is carried out by the university and the scientific organization independently on the basis of credit technology of training.

The Master's degree in scientific and pedagogical direction implements educational programs of postgraduate education for the training of scientific and scientific-pedagogical personnel for universities and scientific organizations with in-depth scientific-pedagogical and research training.

The content of the Master's degree program consists of:

- 1) theoretical training, including the study of cycles of basic and core disciplines;
- 2) practical training of undergraduates: various types of practices, scientific or professional internships;
- 3) research work, including the implementation of a master's thesis for a scientific and pedagogical master's degree
- 4) final certification.

The educational program includes the following stages of preparation of undergraduates: English (professional), management psychology, history and philosophy of science, higher school pedagogy, ore preparation and pre-concentration, geotechnological methods of complex processing of poor mineral raw materials, theory and practice of processing of gold-bearing raw materials, special chapters of the theory of flotation processes, hardware and technological features of the process of ore preparation, waste-free technologies enrichment production, modern technologies for the enrichment and processing of mineral raw materials and man-made waste, theory and practice of processing uranium-containing ores and concentrates, theory of separation of minerals in the enrichment processes, promising areas of mineral enrichment, wastewater treatment processes of processing plants, thickening and dehydration of mineral raw materials, filtration and drying of processed and enriched products, project management, labor protection and environment in the processes of mineral processing, modern methods of

designing mineral processing facilities, chemistry of surface phenomena of the flotation process, theory and practice of polymetallic ore processing, theory and practice of processing rare metal ores, theory and practice of processing non-ferrous metal ores.

The ability to choose disciplines from the catalog of elective disciplines of Satbayev University.

Types of professional activity

Graduates of the educational program of the *scientific and pedagogical* magistracy "Mineral enrichment" can perform the following types of professional activities: design, production and technological, organizational and managerial, research and pedagogical.

A distinctive feature of the master's degree program is that the educational program provides knowledge, skills and abilities for the production and sale of processing products; for the development of regulatory and technical documentation of the mining and processing sector; for the improvement and preparation of mining and processing facilities. Graduates gain knowledge in the field of development and implementation of enrichment technologies, graduates have high leadership and organizational qualities; they are capable of creating small knowledge-intensive mining and processing businesses.

The mission of the Master's degree program "Mineral enrichment" on the basis of the specialty 6M073700 – "Mineral enrichment" is the formation of students' socio-personal qualities and professional competencies that allow graduates to successfully solve production and technological, organizational and managerial, project tasks in the field of mineral enrichment, and contribute to their sustainable demand in the labor market, as well as compliance with international education standards; providing enterprises with highly qualified specialists in the field of mineral processing, specializing in the implementation of promising fundamental, innovative, digital and applied research and development and implementation of modern technological processes that ensure high quality products with minimal costs.

Objects of professional activity.

The objects of professional activity of graduates are processing plants, enterprises of chemical, mining, chemical and machine-building industries, branch research and design institutes, factory laboratories, higher and secondary vocational educational institutions, state management bodies and organizations of various organizational and legal forms.

Types and subjects of professional activity.

The subjects of professional activity are technological processes of the mining and processing industry, processing of raw materials, equipment of mining and processing production, automatic control systems of processing production and quality control of final products.

2. The purpose and objectives of the educational program

The purpose of EP «7M07226 – Mineral processing» is:

– Formation of scientific and pedagogical personnel in the field of mineral processing, focused on the development of modern environmentally energy-saving technologies, the development of design competencies that contribute to improving the efficiency of processing raw materials and reducing the volume of man-made waste.

The objectives of the EP «7M07226 – Mineral processing» are: – the competence of graduates in design and technological work in the implementation of projects to improve and optimize enrichment processes, increase their productivity and improve the quality of products.

– competence of graduates in the implementation of the development and implementation of technological processes for processing mineral, natural and man-made raw materials;

– competence of graduates in the assessment of innovation and technological risks in the introduction of new technologies;

– competence of graduates in the system of digitalization of mineral processing industries. Acquisition of competencies in production management at all stages of the life cycle of manufactured products;

– competence in the marketing of high-tech technologies.

– providing affordable and high-quality education, developing professional skills, eliminating gender inequality, supporting sustainable development and inclusive learning environments;

– improving resource efficiency, creating sustainable production and consumption patterns, and supporting economic growth without harming the environment;

– development of sustainable industrialization, modernization of infrastructure, support for scientific research and innovative technologies;

– efficient use of natural resources, minimization of waste, rational management of chemicals;

– support for international cooperation, development and dissemination of environmentally sound technologies.

3. Requirements for evaluating the learning outcomes of an educational program

Requirements for the key competencies of graduates of the scientific and pedagogical Master's degree

A graduate of the scientific and pedagogical magistracy, must:
have an idea:

- on the role of science and education in public life;
- about current trends in the development of scientific knowledge;
- on current methodological and philosophical problems of natural sciences;
- about the professional competence of a high school teacher;
- contradictions and socio-economic consequences of globalization processes;
- about the latest discoveries in the chosen field of activity, the prospects of their use for the construction of technical systems and devices;
- mathematical and physical modeling of systems in the field of technology and equipment development;
- about design, research, inventive, innovative activities in the field of mineral processing;
- about the possibilities of advanced scientific methods and technical means, to use them at the level necessary for the study of mining and processing processes and equipment.

to know:

- methodology of scientific knowledge;
- principles and structure of the organization of scientific activity;
- psychology of cognitive activity of students in the learning process;
- psychological methods and means of improving the effectiveness and quality of training;
- international and domestic standards, resolutions, orders, orders of higher and other domestic organizations, methodological normative and guidance materials related to the work performed;
- current state and prospects of technical and technological development of enrichment processes, features of the activities of institutions, organizations, enterprises and related industries;
- goals and objectives facing a specialist in the field of mineral processing for the development and implementation of the latest high-tech production technologies;
- methods of research of processing and processes, equipment operation;
- basic requirements for technical documentation of materials and products;
- rules and norms of labor protection, issues of environmental safety of technological processes;
- methods of expert assessment in the field of life safety and environmental protection;

- standards in the field of quality management;
- achievements of science and technology, advanced domestic and foreign experience in the field of mineral processing;
- at least one foreign language at a professional level that allows conducting scientific research and practical activities;
- the methodology of conducting all types of training sessions and independent work of students.

be able to:

- to develop technological processes for obtaining conditioned concentrates from ore, as well as metals from concentrates, processing of metals and alloys, schemes of processing processes, to justify regime parameters and indicators;
- to draw up a business plan for a technological project;
- develop energy- and resource-saving technologies in the field of mineral processing;
- develop environmental protection measures for enrichment production;
- carry out planning of experimental studies, choose research methods;
- to develop the scheme and design of the experimental installation, to carry out installation and debugging;
- process data using planning techniques, regression and correlation analysis, digitalization methods;
- to carry out measures for the organization of production in accordance with regulatory documents;
- to use the acquired knowledge for the original development and application of ideas in the context of scientific research;
- critically analyze existing concepts, theories and approaches to the analysis of processes and phenomena;
- integrate knowledge gained in different disciplines to solve research problems in new unfamiliar conditions;
- by integrating knowledge to make judgments and make decisions based on incomplete or limited information;
- apply the knowledge of pedagogy and psychology of higher education in their teaching activities;
- apply interactive teaching methods;
- to carry out information-analytical and information-bibliographic work with the involvement of modern information technologies;
- to think creatively and creatively approach the solution of new problems and situations;
- be fluent in a foreign language at a professional level, which allows conducting scientific research and teaching special disciplines in universities;
- to summarize the results of research and analytical work in the form of a dissertation, scientific article, report, analytical note, etc.;

have skills:

- research activities, solutions of standard scientific tasks;
- implementation of educational and pedagogical activities on credit technology of training;

- methods of teaching professional disciplines;
- the use of modern information technologies in the educational process;
- professional communication and intercultural communication;
- oratory, correct and logical formalization of their thoughts in oral and written form;
- expanding and deepening the knowledge necessary for daily professional activities and continuing education in doctoral studies.

be competent:

- in the field of research methodology;
- in the field of scientific and scientific-pedagogical activity in higher educational institutions;
- in matters of modern educational technologies;
- in the implementation of scientific projects and research in the professional field;
- in ways to ensure constant updating of knowledge, expansion of professional skills and abilities.

B – Basic knowledge, skills and abilities

B1 - Know the history and philosophy of science, pedagogy and psychology;

B 2 - The ability to independently apply methods and means of cognition, learning and self-control to acquire new knowledge and skills, including in new areas directly unrelated to the field of activity.

B 3 - To speak the state, Russian and one of the most common foreign languages in the industry at the level that provides human communication.

B4 - Be able to use fundamental general engineering knowledge, the ability to practically use the basics and methods of mathematics, physics and chemistry in their professional activities.

B5 - Proficiency in professional terminology and the ability to work with educational and scientific materials in the specialty in the original in a foreign language. The ability to logically correctly, argumentatively and clearly build oral and written speech.

B6 - General engineering skills.

B7 - Possession of fundamental knowledge on the theory of mineral enrichment;

B8 - Basic knowledge of waste management, metal recycling.

B9 - Possession of modern and promising technologies of enrichment production.

B10 - To know and own the main business processes in an industrial enterprise.

B11 - The ability to conduct pedagogical work using modern techniques and technologies.

P – Professional competencies:

P1 - a wide range of theoretical and practical knowledge in the professional field;

P2 - is able to analyze technological lines of mineral processing.

P3 - ready to install, adjust and operate production systems for mineral processing;

P4 - ready to participate in the development and design of new technologies and production lines for mineral processing, production of finished metal-containing products.

P5 - Have the skills of drawing up an equipment and technological scheme

P6 - Possess the skills to carry out technological, thermal and energy calculations

P7 - Be able to calculate aero- and hydrodynamics according to the circuit diagram of the apparatus

P8 - Be able to calculate and select the main and auxiliary equipment

P9 - Be able to develop and select drawings of equipment, buildings and structures

P10 - Be able to develop technological processes for the production and processing of metals and alloys

P11 - Be able to develop a scheme of enrichment processes, justify regime parameters and indicators

P12 - Be able to draw up a business plan for a technological project

P13 - Be able to develop energy- and resource-saving technologies in the field of mineral processing

P14 - Be able to develop environmental protection measures for enrichment production

P15 - Be able to conduct a literary search, compile reports, reviews, conclusions, etc., choose research methods, plan and conduct necessary experiments, analyze and summarize research results, issue patents

P16 - Mastering the technology of processing slags and industrial products of non-ferrous and ferrous metallurgy for additional extraction of valuable components and solving environmental problems of the industrial region

P17 -The ability to use the knowledge, skills, and skills acquired in the course of training to develop a methodology for conducting research related to the professional field and to organize experiments with the analysis of their results

P18 - To identify issues related to the modernization and introduction of new technologies and equipment for the intensification of enrichment processes in order to increase the extraction of valuable components contained therein

P19 - Possess practical skills in the field of independent organization and management of research works on the topic

P20 - The ability to apply the knowledge, skills, and skills acquired in the process of studying under the Master's degree program.

O - Universal, social and ethical competencies

O 1 - is able to use English fluently as a means of business communication, a source of new knowledge in the field of automation or robotization of production processes. I am ready to use English in my professional activity in the field of enrichment;

O2 - is able to speak Kazakh (Russian) fluently as a means of business communication, a source of new knowledge in the field of automation or

robotization of production processes. I am ready to use the Kazakh (Russian) language in my professional activity in the field of enrichment;

O3 - to know and apply the basics of applied ethics and ethics of business communication in work and life;

O4 - know and apply the basic concepts of professional ethics;

O5 - to know and solve the problems of human influence on the environment.

C – Special and managerial competencies

From 1 - independent management and control of the processes of labor and educational activities within the framework of the strategy, policy and goals of the organization, discussion of problems, reasoning conclusions and competent information management;

C2 - to be a specialist in conducting experimental studies of ore processing facilities;

C3 - to be a researcher, a specialist in scientific research of ore processing facilities and objects of finished metal-containing products;

C4 - to be an engineer for the development and design of processing plants, factories, production lines.

4. Passport of the educational program

4.1. General information

№	Field name	Note
1	Code and classification of the field of education	7M07 - Engineering, manufacturing and construction industries
2	Code and classification of training areas	7M072 - Manufacturing and processing industries
3	Group of educational programs	M118 – Mineral processing
4	Name of the educational program	7M07226 – Mineral processing
5	Brief description of the educational program	The educational program "Mineral enrichment" includes fundamental, natural science, general engineering and professional training of masters in the field of mineral enrichment in accordance with the development of science and technology, as well as the changing needs of the mining and processing industry.
6	Purpose of the EP	formation of personnel for the mining and processing industry, covering modern energy-saving technologies, project activities, innovative solutions, entrepreneurship in the high-tech field of mineral and man-made raw materials enrichment
7	Type of EP	New
8	The level of the NRK	7
9	ORC Level	7
10	Distinctive features of the EP	Two - degree Educational Pr
11	List of competencies of the educational program:	Professional competencies; Research competencies; Basic competencies and knowledge; Communication competencies; Universal competencies; Management competencies; Cognitive competencies; Creative competencies; Information and communication competencies
12	Learning outcomes of the educational program:	LO1 - They apply professional vocabulary and communication strategies in English in scientific and interpersonal communication; Analyze philosophical concepts of natural science, substantiate the importance of natural sciences for the formation of a scientific worldview and engineering thinking; Evaluate modern research directions in the field of mineral processing, interpret their significance for the technological and environmental development of the industry. LO2 - They explain the principles of the functioning of modern scientific equipment and carry out its practical application in laboratory and scientific research on mineral processing; Apply modern enrichment methods and technologies to enhance the extraction of valuable components with optimal use of

		resources; Use software to process experimental data, as well as to collect, analyze, store and transmit information within the framework of independent scientific activities; They critically evaluate scientific sources, identify current scientific problems, and design strategies for solving them using modern research approaches. LO3 - They summarize theoretical knowledge and implement physical and experimental methods in solving problems in the field of enrichment; Demonstrate willingness to participate in professional scientific discussions, argue their position in scientific discussions; Apply modern pedagogical technologies and methods of quality control of education, evaluate educational results in professional training; Analyze and interpret international environmental standards, adopt them in calculation in the design of technological solutions. LO4 - process and evaluate the results of research work; are able to apply the methods of technical and economic analysis; are able to choose research methods, plan and conduct the necessary experiments, interpret the results and draw conclusions; are able to carry out elements of mineral enrichment projects.
13	Form of training	Full - time
14	Duration of training	2 years
15	Volume of loans	120
16	Languages of instruction	Kazakh, russian, english
17	Academic degree awarded	Master of Technical Sciences
18	Developer and author:	Barmenshinova M.B.

4.2. The relationship between the achievability of the formed learning outcomes according to the educational program and academic disciplines

№	Name of the discipline	Brief description of the discipline	Кол-во кредитов	Generated learning outcomes (codes)			
				LO1	LO2	LO3	LO4
Cycle of basic disciplines							
University component							
1	Foreign language (professional)	Mastering professional English at an advanced level (for non-linguistic areas). The study of grammatical characteristics of scientific style in its oral and written forms. Professional oral communication in monological and dialogical form according to the educational program. Ability to demonstrate the results of research in the form of reports, abstracts, publications and public discussions; interpret and present the results of scientific research in a foreign language.	5	V	V		
2	Psychology of management	The course is aimed at mastering the tools for effective employee management, based on knowledge of the psychological mechanisms of the manager's activity. Discipline will help you master the skills of making decisions, creating a favorable psychological climate, motivating employees, setting goals, building a team and communicating with employees. At the end of the course, undergraduates will learn how to resolve managerial conflicts, create their own image, analyze situations in the field of managerial activity, as well as negotiate, be stress-resistant and effective leaders.	3	V	V		
3	History and philosophy of science	Purpose: to explore the history and philosophy of science as a system of concepts of global and Kazakh science. Content: the subject of philosophy of science, dynamics of science, the main stages of the historical development of science, features of classical science, non-classical and post-non-classical science, philosophy of mathematics, physics, engineering and technology, specifics of engineering sciences, ethics of science, social and moral responsibility of a scientist and engineer.	3	V	V		
4	Higher school pedagogy	The course is aimed at mastering the methodological and theoretical foundations of higher education pedagogy. The discipline will help to master the skills of modern pedagogical technologies, technologies of pedagogical design, organization and control in higher education, skills of communicative competence. At the end of the course, undergraduates learn how to organize and conduct various forms of organizing training, apply active teaching methods, and select the content of training sessions. Organize the educational process on the basis of credit technology of education.	3	V	V		
Cycle of basic disciplines							
Component of choice							
5	Ore preparation and pre-concentration	Purpose: to master the principles and methods of ore preparation and preconcentration by undergraduates, including modern approaches and technologies to improve the efficiency of mineral processing processes. Contents: Introduction to ore preparation	5		V	V	

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		and preconcentration processes; Physico-chemical features of ores and their influence on ore preparation methods; Crushing and crushing of ores; Gravity methods of preconcentration; Magnetic methods of preconcentration; Flotation as a method of preconcentration; Electrostatic separation for preconcentration; Mathematical modeling of ore preparation and preconcentration processes; Design and optimization of equipment for ore preparation and preconcentration; Intensification of ore preparation and preconcentration processes; Environmental and economic aspects of ore preparation and preconcentration; Methods for evaluating the effectiveness of ore preparation and preconcentration processes; Prospects and innovations in ore preparation and preconcentration; Practical research and laboratory work in the field of ore preparation and preconcentration.					
6	Geotechnological methods of complex processing of mineral raw materials	Purpose: undergraduates to master modern geotechnological methods of complex processing of poor mineral raw materials, including methods of enrichment, intensification of processes, as well as environmental and economic optimization of processing. Contents: Introduction to geotechnological methods of complex processing of poor mineral raw materials; Physico-chemical features of poor mineral raw materials; Geotechnological methods of enrichment of poor raw materials: general principles and classification; Geotechnological methods of enrichment using biotechnologies; Gravitational separation of poor ores: methods, equipment and optimization of processes; Flotation in the processing of poor ores: theoretical foundations and modern technologies; Magnetic separation: principles, methods and applications for poor ores; Electrostatic separation: opportunities and limitations in the processing of poor ores; Mathematical modeling of processes of processing poor ores; Methods of intensification of processes of processing poor ores: the latest approaches and technologies; Design and optimization of equipment for processing poor ores; Environmental and economic aspects of processing poor ores; Waste disposal of processing plants: technologies for processing tailings and slags; Prospects and prospects innovations in geotechnologies for processing poor ores; Practical and research work: laboratory studies and industrial studies of the processes of processing poor ores.	5		V	V	
7	Theory and practice of processing of gold-containing raw materials	Purpose: to study the theoretical foundations and practical methods of processing gold-bearing raw materials, including modern technologies for processing and extracting gold. Contents: Introduction to the processing of gold-containing raw materials; Physico-chemical features of gold-containing raw materials; Methods of enrichment of gold-containing raw materials; Cyanide and cyanide-free extraction of gold; The process of amalgamation in the processing of gold ores; Intensification and optimization of gold processing processes; Mathematical modeling of gold ore processing processes; Processing of complex and low-grade gold ores; Gold purification and recovery technologies; Environmental and economic aspects of gold processing; Modern approaches to the processing of gold-bearing waste; Prospects and innovations in the processing of gold-bearing ores; Design of equipment for processing gold-bearing raw materials; Practical and research work in the field of gold ore processing.	5			V	V

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8	Special chapters of the theory of flotation processes	Purpose: in-depth study of theoretical and practical aspects of flotation processes, including physico-chemical principles, kinetics, reagent application, intensification methods and mathematical modeling. Contents: Introduction to the theory of flotation processes; Physico-chemical fundamentals of flotation; Reagents in flotation: types, mechanisms of action, application; Kinetics of flotation: basic models and theoretical approaches; Methods of intensification of flotation processes; Mathematical modeling of flotation processes; Modernization and design of flotation plants; Optimization of flotation processes depending on the characteristics of minerals; Use of artificial intelligence in flotation processes; Environmental aspects of flotation: reducing environmental impact; Modern methods of analysis and control of flotation processes; Flotation and processing of complex and low-grade ores; Energy efficiency of flotation processes; Prospects and innovations in the field of flotation; Practical research and laboratory work on flotation.	5			V	V
9	Intellectual property and research	The purpose of this course is to provide undergraduates with the knowledge and skills necessary to understand, protect and manage intellectual property (IP) in the context of scientific research and innovation. The course is aimed at training specialists who can effectively work with IP, protect the results of scientific research and apply them in practice.	5			V	V
10	Hardware and technological features of process of ore dressing	Purpose: to provide undergraduates with the knowledge and skills necessary for a deep understanding and effective application of hardware and technological solutions in the ore preparation process. Contents: Physical and mechanical properties of ores and their influence on the choice of equipment and modes of ore preparation; Crushing technologies and equipment: classification, principles of operation, choice of modes; Fine and ultrafine grinding: mills, structures, modes and control; Selection and classification of crushing and grinding products; Dry and wet modes of ore preparation: comparative analysis technology selection; Intensification of ore preparation processes using modern technologies; Mathematical modeling and digital counterparts of ore preparation processes; Design of ore preparation sites: principles, schemes, engineering solutions; Energy efficiency and resource conservation in ore preparation; Environmental aspects of ore preparation: dust formation, noise, wear of equipment; Automated control systems for ore preparation; Evaluation of the effectiveness of ore preparation processes: analytical and experimental methods; Practical and research work: laboratory and industrial studies of ore preparation processes; Prospects for the development of ore preparation technologies.	5			V	V
11	Non-waste technology processing industry	Purpose: to provide undergraduates with a systematic understanding and practical skills in the use of waste-free technologies in the processing of mineral raw materials. Contents: Principles of waste-free technologies in the processing of mineral raw materials; Stages and processes of waste-free processing: from extraction to enrichment; Resource-saving enrichment methods: flotation, gravity and magnetic separation; Waste disposal of enrichment production: technologies and methods; Modern methods of intensification of enrichment processes with waste minimization; Application of	5			V	V

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		membrane and filtration technologies for waste-free production; Environmental aspects of waste-free enrichment technologies; Mathematical modeling and optimization of waste-free processes; Design of equipment for waste-free technologies; Introduction of waste-free technologies into industrial production; Introduction of waste-free technologies into industrial production; Evaluation of the effectiveness of waste-free technologies: methods and approaches; Prospects and innovations in the field of waste-free technologies of enrichment production; Practical research and experimental work in the field of waste-free technologies.					
12	Sustainable development strategies	Purpose: To train graduate students in sustainable development strategies to achieve a balance between economic growth, social responsibility, and environmental protection. Content: Graduate students will study the concepts and principles of sustainable development, the development and implementation of sustainable development strategies, the evaluation of their effectiveness, and international standards and best practices. Cases and examples of successful sustainable development strategies are included.	5			V	V
Cycle of profile disciplines University component							
13	Modern technologies of enrichment and processing of mineral raw materials and technogenic waste	Purpose: to provide undergraduates with the knowledge and skills necessary for the development, optimization and implementation of modern technological processes in the field of mineral processing and processing of man-made waste. Contents: Introduction to technologies of enrichment and processing of mineral raw materials and man-made waste; Basic enrichment processes: classification, principles and modern methods; Modern methods of intensification of mineral enrichment processes; Processing of man-made waste: methods, technologies and environmental aspects; Modeling and optimization of enrichment and processing processes; Automation and control of enrichment and processing processes; Engineering and scientific developments in the field of new materials for processing mineral raw materials; Analysis of the sustainability of enrichment and processing processes in the face of changing external factors; Design of new technological lines for processing mineral raw materials and man-made waste; Environmental and economic aspects of processing mineral raw materials and man-made waste; Innovations in alternative technologies for waste processing and disposal; Research work: current trends in enrichment and processing technologies.	5			V	V
14	Theory and practice of uranium ore and concentrates processing	Purpose: to provide undergraduates with in-depth knowledge of modern methods and technologies for processing uranium-containing ores and concentrates, as well as to develop practical skills in designing, optimizing and intensifying uranium processing processes. Contents: Introduction to the processing of uranium-containing ores: goals, objectives and methods; Mineralogy and geochemistry of uranium-containing ores; Basic methods of enrichment of uranium-containing ores; Chemical processing of uranium-containing ores; Hydrometallurgical processing of uranium ores; Modeling and optimization of processes for processing uranium-containing ores; Technologies for	5			V	V

NON-PROFIT JOINT-STOCK COMPANY "KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY
named after K.I. SATPAYEV"

		processing uranium-containing concentrates; Engineering and scientific developments to improve the efficiency of processing uranium-containing ores; Environmental aspects of processing of uranium-containing ores; Design of technological schemes for processing uranium-containing ores; Innovations and alternative technologies for processing uranium-containing ores; Research work: current trends and scientific developments in the field of processing uranium-containing ores					
15	The theory of the separation of minerals in beneficiation processes	Purpose: to provide undergraduates with in-depth knowledge and skills necessary to understand, design and optimize mineral separation processes within the framework of mineral processing. Contents: Introduction to the theory of mineral separation in enrichment processes; Physico-chemical foundations of mineral separation processes; Gravitational separation of minerals: theoretical foundations and modern methods; Magnetic separation of minerals: principles, methods and applications; Flotation processes: theoretical foundations and methods of intensification; Electrostatic separation of minerals: theoretical foundations and modern equipment; Physical-chemical separation methods: ion exchange, flotation, coagulation and flocculation; Mathematical modeling of mineral separation processes; Intensification of mineral separation processes using new technologies; Optimization of mineral separation processes: methods and technologies; Environmental aspects and waste management in mineral separation processes; Prospects and innovations in the field of mineral separation; Design and analysis of the effectiveness of mineral separation processes; Practical work and experimental research in the field of mineral separation.	5		V	V	V
16	Advanced mineral processing for eco-mining	Purpose: to train specialists with the knowledge and skills to develop and implement innovative technologies for processing mineral raw materials that minimize environmental risks, effectively use natural resources and reduce negative environmental impacts. Contents: Introduction to advanced processing of mineral raw materials for eco-mining; Modern approaches to processing mineral raw materials with minimizing environmental impact; Environmental and economic aspects of eco-mining; Intensification of enrichment processes with an environmental focus; Technologies for waste-free processing of mineral raw materials; Resource-saving methods of processing mineral raw materials; The use of biotechnologies in the processing of mineral raw materials; Mathematical modeling of processes of eco-mining and processing; Modern methods of wastewater treatment in processing plants; Environmental technologies for processing waste from processing processes; Assessment and monitoring of environmental risks in the process of processing mineral raw materials; Design of equipment for eco-mining and processing; Innovations and prospects for the development of eco-mining and processing of mineral raw materials; Design of management systems for eco-mining and processing of mineral raw materials; The impact of the legislative and environmental framework on processes eco-mining.	5			V	V
17	Process wastewater concentrators	Purpose: to familiarize undergraduates with the theoretical foundations and practical methods of wastewater treatment at enrichment plants, as well as with modern technologies and approaches aimed at improving the efficiency of treatment processes,	5			V	V

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named after K.I. SATPAYEV"

		minimizing environmental impacts and rational use of water resources. Contents: Introduction to wastewater treatment processes in processing plants; Physico-chemical wastewater treatment processes; Mechanical wastewater treatment methods: filtration, precipitation, flotation; Modern wastewater treatment technologies in processing plants; Wastewater treatment using flocculants and coagulants; Intensification of wastewater treatment processes; Mathematical modeling and optimization wastewater treatment processes; Environmental aspects of wastewater treatment in processing plants; Design and operation of wastewater treatment plants; Recycling and disposal of waste from wastewater treatment; Prospects and innovations in wastewater treatment of processing plants; Design of control systems and monitoring of wastewater treatment processes; Practical research and laboratory work on wastewater treatment.					
Cycle of profile disciplines Component of choice							
18	Thickening and dehydration of mineral raw materials	Purpose: to provide undergraduates with in-depth theoretical and practical knowledge about the processes of thickening and dewatering of mineral raw materials, their mathematical modeling, intensification and optimization, as well as in mastering methods of analysis, design and evaluation of the effectiveness of appropriate equipment. Contents: Fundamentals of the processes of thickening and dewatering of mineral raw materials; Mathematical modeling of the processes of thickening and dewatering; Intensification of the processes of thickening and dewatering of mineral raw materials; Physico-chemical properties of suspensions and their effect on the processes of thickening and dewatering; Modern methods of dewatering: filtration, centrifugation, drying; Design and optimization of equipment for thickening and dewatering; Modern approaches for the purification and processing of wastewater using thickening processes; Implementation and analysis of the energy efficiency of thickening and dewatering processes; Application of nanomaterials and flocculants to improve thickening processes; Methods for analyzing and evaluating the effectiveness of thickening and dewatering processes; Environmental aspects and waste management during thickening and dewatering; Prospects for the development of thickening and dewatering technologies for processing mineral resources; Practical research and experimental work in the field of thickening and dewatering dehydration.	5		V	V	
19	Modeling of uranium mining and metallurgy processes	Purpose: to study the basics of modeling techniques for uranium mining and metallurgy processes, principles of model construction, and analysis of the results obtained. Contents: The main stages of field development and the stages of their mathematical modeling. An overview of modeling application packages. Reservoir permeability, mineral content. Construction of geological models of deposits. Interpolation of borehole data. Balance sheet and off-balance sheet ores. Counting stocks. Theoretical foundations and mathematical models of filtration of the solution in the reservoir. Darcy's law. The Dupuy formula. Fundamentals of computational mathematics. Methods for modeling the flow of solution in a reservoir. Current lines. Spreading of the solution outside the block. The distribution of the flow rate along the filter. (Distribution	4				

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named after K.I. SATPAYEV"

		through BP production rates by wells). Chemical model of the process. Building a mathematical model of chemistry. Types of colmatation. Simulation of colmatation. Technical and economic models. Simulation modeling of mining scenarios and forecasting of the mining process. Ways to intensify the process of underground borehole leaching of uranium.					
20	Wastewater treatment and conditioning of recycled water	Purpose: to provide undergraduates with deep theoretical knowledge and practical skills necessary for the development and application of effective wastewater treatment and recycled water conditioning technologies in industry. Contents: Fundamentals of wastewater treatment and conditioning of recycled water in industry; Mechanical methods of wastewater treatment: filtration, precipitation, flotation; Physico-chemical methods of wastewater treatment: coagulation, flocculation, ion exchange; Mathematical modeling of wastewater treatment processes; Design and optimization of equipment for water treatment and conditioning; Environmental aspects and disposal waste from wastewater treatment; Use of renewable energy sources for wastewater treatment; Analysis of the effectiveness of wastewater treatment processes: assessment and monitoring methods; Modern approaches to wastewater treatment and treatment in the mining and metallurgical industries; Prospects and innovations in the field of wastewater treatment and recycled water conditioning; Practical research and experimental work in the field of wastewater treatment.	4				
22	Filtration and drying of processed and enriched products	Purpose: to provide undergraduates with deep theoretical and practical knowledge about filtration and drying processes used in the processing and enrichment of mineral raw materials. Contents: Modern trends and methods of intensification of filtration and drying processes in the processing of mineral raw materials; Mathematical modeling of filtration and drying processes: theoretical and practical aspects; Methods of filtration intensification using membrane technologies; Optimization of drying processes using low-temperature technologies; Physico-chemical features of filtration and drying of mineral solutions and suspensions; Design and optimization of equipment for filtration and drying in the mining and metallurgical industries; Engineering and scientific methods for the development of filtration and drying processes based on the analysis of experimental data; Methods and technologies for cleaning and drying mineral waste; Analysis and design of energy-saving and environmentally friendly filtration and drying technologies; Use of a filtration and drying process control system with elements of artificial intelligence; Practical research and experimental work in the field of filtration and drying; Prospects and the directions of further research in the field of filtration and drying for processing mineral raw materials.	5		V	V	V
22	Project Management	Goal: Gaining knowledge about the components and methods of project management based on modern models and standards. Objectives: study of behavioral models of project-oriented management of business development; mastering international standards PMI PMBOK, IPMA ICB and national standards of the Republic of Kazakhstan in the field of project management; analysis of the features of organizational management of business development through the integration of	5	V	V		

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		strategic, project and operational management.					
23	Labor and environmental protection in mineral processing processes	Purpose: to provide undergraduates with a systematic understanding of the principles of industrial safety, employee health and environmental protection in the processing of mineral raw materials, as well as in developing skills in analyzing, designing and justifying engineering and scientific solutions aimed at reducing occupational risks and minimizing man-made environmental impacts. Contents: Legislation and regulatory framework in the field of labor and environmental protection; Introduction to labor and environmental protection in mineral processing; Harmful factors in mineral processing processes; Modern approaches to industrial safety in enrichment production; Intensive and environmentally friendly technologies for mineral processing; Purification and disposal of industrial emissions wastewater and waste; Monitoring and control of environmental pollution; Radiation and chemical safety at enrichment plants; Psychophysiological aspects of labor protection in enrichment production; Design of safe and environmentally sustainable enrichment plants; Innovative solutions in labor protection and ecology: digitalization and automation; Research work: current trends in labor protection and environmental safety.	5		V	V	V
24	Modern methods of design of mineral processing facilities	Purpose: to develop undergraduates' systemic knowledge and practical skills necessary for the integrated engineering design of mineral processing facilities, taking into account modern technologies, digital tools, resource and environmental efficiency requirements, as well as in developing competencies to substantiate their own design and scientific solutions in the context of current technological and regulatory challenges. Contents: Introduction to modern design of mineral processing facilities; Analysis and evaluation of initial data for design; Methodology and stages of design of technological schemes of enrichment; Optimization of technological schemes using digital methods; Energy and resource aspects of design of processing plants; Modern approaches to the selection and design of equipment; Design of automation systems and process control; Engineering design of auxiliary systems (water supply, ventilation, transport); Environmental design and environmental impact assessment (EIA); Regulatory and legal aspects of the design of enrichment facilities; Innovative and alternative technologies in the design of enrichment facilities; Research and design work: development and justification of design solutions.\	5			V	V
25	Surface chemistry flotation process	Purpose: to provide undergraduates with theoretical and practical knowledge about the chemical and physico-chemical foundations of surface phenomena occurring during flotation, as well as in the development of methods for the intensification, optimization and modeling of these processes. Contents: Fundamentals of chemistry of surface phenomena in flotation: theory and practice; Chemicals used in flotation: reagents and their effect on processes; Modern methods of intensification of the flotation process; Mathematical modeling of surface phenomena and the flotation process; Physico-chemical properties of minerals affecting flotation properties; Environmental aspects of flotation and their impact on the choice chemical reagents; Optimization of flotation processes: experimental research and analysis methods; Design and optimization of	5		V	V	V

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named after K.I. SATPAYEV"

		flotation plants; The role of artificial intelligence and control systems in flotation processes; Methods of purification and enrichment of mineral resources using flotation; Application of flotation in waste processing: recycling and recovery of valuable components; Prospects and directions for further research in the field of chemistry of surface phenomena of flotation.					
26	Theory and practice of processing of polymetallic ores	Purpose: to provide undergraduates with a set of knowledge and practical competencies necessary for the analysis, design, optimization and scientific justification of technological processes for processing polymetallic ores, taking into account their mineralogical characteristics, the current state of scientific and technological development, resource and environmental efficiency requirements, as well as regulatory and economic factors. Contents: Introduction to polymetallic ore processing; Mineralogical and physico-chemical bases of polymetallic ore processing; Flotation methods of polymetallic ore processing; Gravity and magnetic methods of polymetallic ore processing; Hydrometallurgical methods of metal extraction from concentrates; Complex extraction and utilization of by-products and related components; Optimization of technological schemes for polymetallic ore processing; Design of technological schemes and selection of equipment; Modern methods of intensification and automation of polymetallic ore processing; Environmental aspects of polymetallic ore processing; Regulatory, legal and economic aspects of polymetallic ore processing; Research and design work: development of technological solutions.	5		V		V
27	Industrial waste management, resource recovery and recycling technologies	The purpose of this discipline is to study modern waste treatment methods, as well as the development of new technologies and solutions to improve industrial waste management. The course content includes the study of the basic principles of waste management, waste recycling technologies, as well as methods and tools for managing and controlling the processes of recycling and resource recovery. This discipline not only helps to reduce the negative impact of industrial waste on the environment, but also helps to save resources and create a sustainable production model.	5			V	V
28	Theory and practice of processing of non-ferrous metals	Purpose: to provide undergraduates with deep theoretical knowledge and practical skills necessary for the development, optimization and implementation of technological processes for processing non-ferrous metal ores. Contents: Introduction to the processing of non-ferrous metal ores; Mineralogical and physico-chemical bases of processing non-ferrous metal ores; Flotation methods of processing non-ferrous metal ores; Gravitational and magnetic methods of enrichment of non-ferrous metal ores; Hydrometallurgical methods of extraction of non-ferrous metals from ores; Complex extraction of by-products and related components from non-ferrous metal ores; Optimization of technological schemes of ore processing non-ferrous metals; Design of technological schemes and equipment selection; Modern methods of intensification of processing of non-ferrous metals; Automation and digitalization of non-ferrous metal ore processing processes; Environmental aspects of non-ferrous metal ore processing; Regulatory, legal and economic aspects of non-ferrous metal ore processing; Research and design work: development of technological solutions.	5			V	V

5. Curriculum of the educational program

NON-PROFIT JOINT STOCK COMPANY
"KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY NAMED AFTER K.I. SATPAYEV"



«APPROVED»
Decision of the Academic Council
NPJSC «KazNRTU»
named after K.Satbayev»
dated 06.03.2025 Minutes № 10

WORKING CURRICULUM

Academic year 2025-2026 (Autumn, Spring)
Group of educational programs M118 - "Mineral processing"
Educational program 7M07226 - "Mineral processing"
The awarded academic degree Master of Technical Sciences
Form and duration of study full time (scientific and pedagogical track) - 2 years

Discipline code	Name of disciplines	Block	Cycle	Total ECTS credits	Total hours	lek/lab/pr Contact hours	in hours SIS (including TSIS)	Form of control	Allocation of face-to-face training based on courses and semesters				Prerequisites
									1 course		2 course		
									1 sem	2 sem	3 sem	4 sem	
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)													
CYCLE OF BASIC DISCIPLINES (BD)													
M-1. Module of basic training													
LNG213	Foreign language (professional)		BD, UC	3	90	0.0/30	60	E	3				
HUM214	Psychology of management		BD, UC	3	90	15/0/15	60	E	3				
MET712	Ore preparation and pre-concentration	1	BD, CCH	5	150	30/15/0	105	E	5				
MET255	Geotechnological methods of complex processing of mineral raw materials poor	1	BD, CCH	5	150	30/15/0	105	E	5				MET151, CHE192
MET714	Theory and practice of processing of gold-containing raw materials	2	BD, CCH	5	150	30/15/0	105	E	5				
MET266	Special chapters of the theory of flotation processes	2	BD, CCH	5	150	30/15/0	105	E	5				PHY111, MET273, MET1803, MET1823, MET2742
MNG781	Intellectual property and research	2	BD, CCH	5	150	30/0/15	105	E	5				
HUM212	History and philosophy of science		BD, UC	3	90	15/0/15	60	E		3			
HUM213	Higher school pedagogy		BD, UC	3	90	15/0/15	60	E		3			
MET253	Hardware and technological features of process of ore dressing	1	BD, CCH	5	150	30/15/0	105	E			5		MET163, MET1731
MET254	Non-waste technology processing industry	1	BD, CCH	5	150	30/15/0	105	E			5		MET170, MET158
MNG782	Sustainable development strategies	1	BD, CCH	5	150	30/0/15	105	E			5		
M-3. Practice-oriented module													
AAP273	Pedagogical practice		BD, UC	8				R			8		
CYCLE OF PROFILE DISCIPLINES (PD)													
M-2. Module of professional activity													
MET708	Modern technologies of enrichment and processing of mineral raw materials and technogenic waste		PD, UC	5	150	30/0/15	105	E	5				
MET753	Theory and practice of uranium ore and concentrates processing		PD, UC	5	150	30/15/0	105	E	5				
MET723	The theory of the separation of minerals in beneficiation processes		PD, UC	5	150	30/15/0	105	E		5			
MEI240	Advanced mineral processing for eco-mining		PD, UC	5	150	30/0/15	105	E		5			
MET716	Thickening and dehydration of mineral raw materials	1	PD, CCH	5	150	15/15/15	105	E		5			
MET717	Filtration and drying of processed and enriched products	1	PD, CCH	5	150	15/15/15	105	E		5			
MNG705	Project Management	1	PD, CCH	5	150	30/0/15	105	E		5			

NON-PROFIT JOINT-STOCK COMPANY "KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY
named after K.I. SATPAYEV"

MET729	Labor and environmental protection in mineral processing processes	2	PD, CCH	5	150	30.0/15	105	E		5			
MET755	Modern methods of design of mineral processing facilities	2	PD, CCH	5	150	30/1.50	105	E		5			
MET262	Process wastewater concentrators		PD, UC	5	150	30/1.50	105	E			5		MET163, MET180, MET1751
MET274	Surface chemistry flotation process	1	PD, CCH	5	150	30/1.50	105	E			5		MET183, MET299, PHY1112, MET1801, CHE1921
MET267	Theory and practice of processing of polymetallic ores	1	PD, CCH	5	150	30/1.50	105	E			5		MET163, MET159, MET180
MEI241	Industrial waste management, resource recovery and recycling technologies	2	PD, CCH	5	150	30.0/15	105	E			5		
MET269	Theory and practice of processing of non-ferrous metals	2	PD, CCH	5	150	30/1.50	105	E			5		MET163, MET158, MET180
MEI244	Modeling of uranium mining and metallurgy processes	1	PD, CCH	4	120	30.0/15	75	E				4	
MEI245	Wastewater treatment and conditioning of recycled water	1	PD, CCH	4	120	30.0/15	75	E				4	
M-3. Practice-oriented module													
AAP256	Research practice		PD, UC	4				R				4	
M-4. Experimental research module													
AAP268	Research work of a master's student, including internship and completion of a master's thesis		RWMS	4				R	4				
AAP268	Research work of a master's student, including internship and completion of a master's thesis		RWMS	4				R		4			
AAP251	Research work of a master's student, including internship and completion of a master's thesis		RWMS	2				R			2		
AAP255	Research work of a master's student, including internship and completion of a master's thesis		RWMS	14				R				14	
M-5. Module of final attestation													
ECA212	Registration and protection of the master thesis		FA	8								8	
Total based on UNIVERSITY:										30	30	30	30
										60	60		

Number of credits for the entire period of study					
Cycle code	Cycles of disciplines	Credits			
		Required component (RC)	University component (UC)	Component of choice (CCH)	Total
GED	Cycle of general education disciplines	0	0	0	0
BD	Cycle of basic disciplines	0	20	15	35
PD	Cycle of profile disciplines	0	29	24	53
Total for theoretical training:		0	49	39	88
RWMS	Research Work of Master's Student				24
ERWMS	Experimental Research Work of Master's Student				0
FA	Final attestation				8
TOTAL:					120

Decision of the Educational and Methodological Council of KazNRTU named after K.Satpayev. Minutes № 3 dated 20.12.2024

Decision of the Academic Council of the Institute. Minutes № 4 dated 12.12.2024

Signed:
Governing Board member - Vice-Rector for Academic Affairs
Approved:
Vice Provost on academic development
Head of Department - Department of Educational Program Management and Academic-Methodological Work
Director - Mining and Metallurgical Institute named after O.A. Baikunurov
Department Chair - Metallurgy and mineral processing
Representative of the Academic Committee from Employers
____ Acknowledged ____

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