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:	Level 7 – Postgraduate education. Master's degree (based on the mastered bachelor's degree program), practical experience.
ORC Level:	Level 7 – Conceptual professional and/or scientific knowledge (including innovative) and experience in a particular field and/or at the junction of fields. Evaluation and selection of professional information. Creation of new applied knowledge in a certain field. Identification of sources and search for information necessary for the development of activities
Duration of training:	2 years
Volume of loans:	120

Almaty 2024

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

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

Protocol No. 6 dated « 19 » 04 2024.

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

Full name	Academic degree/ academic title	Position	Workplace	Signature
Chairperson of Academic Committee:				
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Teaching staff:				
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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 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 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.

– development and implementation of advanced and environmentally friendly technologies for mineral processing;

– improving the efficiency of processing raw materials and minimizing 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	Mineral enrichment
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	Level 7 – Postgraduate education. Master's degree (based on the mastered bachelor's degree program), practical experience.
9	ORC Level	Level 7 – Conceptual professional and/or scientific knowledge (including innovative) and experience in a particular field and/or at the junction of fields. Evaluation and selection of professional information. Creation of new applied knowledge in a certain field. Identification of sources and search for information necessary for the development of activities
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 - speak a foreign (primarily English) language in the field of professional activity and interpersonal communication; understand the philosophical concepts of natural science, the role of natural sciences in the development of a scientific worldview; have an idea of the most relevant areas of research in the field of mineral enrichment. LO2 - understand the principles of work and are able to work on

		modern scientific equipment when conducting scientific research in the field of mineral enrichment; They are proficient in modern methods of mineral processing aimed at increasing the extraction of valuable components with minimal resource expenditure; possess modern computer technologies used in processing the results of scientific experiments and collecting, processing, storing and transmitting information when conducting independent scientific research; analyze scientific literature, are able to identify and analyze problems, plan a strategy their solutions. LO3 - possess the theoretical foundations and practical skills of physical and experimental research methods in mineral enrichment; have experience of professional participation in scientific discussions; know the organizational forms and principles of the learning process and pedagogical control. They know international environmental standards and regulations. 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 full
14	Duration of training	2 years
15	Volume of loans	120
16	Languages of instruction	Kazakh/Russian
17	Academic degree awarded	Master of Technical Sciences
18	Developer(s) and authors:	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)	The course is aimed at studying the main problems of scientific knowledge in the context of its historical development and philosophical understanding, the evolution of scientific theories, principles and methods of scientific research in the historical construction of scientific paintings of the world. The discipline will help to master the skills of developing critical and constructive scientific thinking based on research on the history and philosophy of science. At the end of the course, undergraduates will learn to analyze the ideological and methodological problems of science and engineering and technical activities in building Kazakhstan's science and the prospects for its development.	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		
5	Philosophical and methodological problems of science and technology	The purpose of the discipline "Philosophical and methodological problems of Science and Technology" is to teach students the analysis of fundamental issues facing modern science and technology. The content of the discipline includes discussions of the main	3	V	V		

		theories of the philosophy of science, methods of scientific cognition, the history of the development of scientific thought, as well as current problems of technological progress and their philosophical aspects.					
6	Professional training in English	Objective: to increase the initial level of foreign language proficiency achieved at the previous stage of education, to master the necessary and sufficient level of communicative competence for undergraduates to solve social and communicative tasks in various fields of everyday, cultural, professional and scientific activities when communicating with foreign partners, as well as for further self-education. Content: Practical basics of public presentation of scientific and technical information in English. Examples of scientific presentations of the results of materials science research, studies of embedded and non-destructive testing of structures. General information about the structure of a modern scientific and technical article in English. Examples of scientific and technical articles in English, their translation and analysis.	6	√	√		
7	Modern processes and devices for processing mineral and man-made raw materials	The purpose of the course: the formation of knowledge about the structure and principles of operation of modern technological equipment in the processing of mineral and technogenic raw materials. Description: Sources of technogenic raw materials; distinctive features of technogenic and geogenic raw materials; a review of modern and prospective processes and apparatus for the processing of mineral and technogenic raw materials. Upon completion of the course, undergraduates will calculate, optimize the parameters of technological processes and equipment for the processing of mineral, technogenic raw materials, taking into account the priority areas of industry in Kazakhstan.	6		√	√	√
8	Modern methods of scientific research in chemical technology	The purpose of the course: the formation of in-depth knowledge of undergraduates in the field of using modern research methods in chemical engineering. Description: methods for studying the structure of crystals, radiography, elemental analysis of matter, electron microscopy, neutron activation analysis, thermal analysis. Upon completion of the course, undergraduates will independently carry out scientific research using instrumental methods of analysis, control processes and manage the quality of the materials obtained, taking into account new achievements in the field of modern equipment and controls.	3			√	√
9	Physics and chemistry of nanomaterials	The purpose of the course: the formation of in-depth knowledge about the fundamental properties of matter in the nanoscale state. Description: Obtaining, studying the structure and properties of nano-objects, prospects for their application and possible risks; sol-gel technology - a method of targeted production of nanomaterials with desired properties, evaluation of its environmental friendliness. Upon completion of the course, undergraduates will independently conduct scientific research, control the synthesis process and the properties of products, determine the degree of safety of nanomaterials for environment using modern methods and means of control.	3			√	√
10	Planning and processing of experiments in chemical technologies	The purpose of the course is to form undergraduates' ideas about the planning, organization of the experiment and methods of analysis of the object under study (process, phenomenon) and develop skills to discuss the results in the scientific environment. Content: General issues of planning and organization of the experiment. Modern methods of analysis of experimental data. Modern methods of experiment planning. Planning an	3		√	√	√

		experiment while searching for optimal conditions.					
Cycle of basic disciplines Component of choice							
11	Ore preparation and pre-concentration	The purpose of this discipline is to study the processes of ore dressing and to develop effective methods and technologies for pretreatment of raw materials. Content: the study of the main methods of physical, chemical and flotation processing of ores, as well as the analysis of modern technologies and equipment used in ore mining and ore preparation. Students will gain knowledge about the processes of ore enrichment, concentration and purification, as well as learn how to conduct laboratory and pilot studies to optimize technological processes.	5		V	V	
12	Geotechnological methods of complex processing of mineral raw materials	The purpose of this discipline is to study technologies and methods that optimize the processing of poor deposits and maximize their potential. Content:The study of this discipline allows specialists in the field of mining and geotechnology to develop and implement innovative approaches to the complex processing of poor deposits, which helps to increase the efficiency of mining and increase the profitability of production.	5		V	V	
13	Theory and practice of processing gold-containing raw materials	The purpose of the discipline is to develop professional competence among undergraduates in the field of theory and practice of processing gold-containing raw materials, modern technologies and equipment. The discipline program expands the basic knowledge of undergraduates on traditional and new technologies for extracting gold from various types of raw materials, and shows the possibility of applying knowledge in research, production and technological activities	5			V	V
14	Special chapters of the theory of flotation processes	The purpose of the special chapters of the theory of flotation processes is to explore deeper aspects of the application of flotation in various industries. Within the framework of this discipline, students study specific flotation technologies and techniques, as well as the principles of operation of modern equipment and reagents. Content: The study of special chapters of the theory of flotation processes allows students to deepen their knowledge in the field of flotation, as well as prepare for work in manufacturing enterprises where flotation technologies are used.	5			V	V
15	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
16	Hardware and technological features of process of ore dressing	Purpose: to propose ways to improve the technology of repair and modernization of processing equipment, describe the technology of installation, work, select the nomenclature and the necessary number of machines and equipment to perform annual production, determine the necessary repair base, frequency and complexity of scheduled technical inspections and repairs. Content: A modern specialist in mining and metallurgical production should know in depth the basics of mechanization and automation of production, operational and	5		V	V	

		technical data of machines and their structural elements.					
17	Non-waste technology processing industry	Purpose: to teach undergraduates as future industry executives the sound development of management decisions based on knowledge about the use of waste-free technologies of enrichment production, which are aimed at protecting the environment Content: on the complex processing of raw materials and materials using all their components based on the creation of new waste–free processes; - on how the use of hydraulic technology can solve the problem of creating environmentally friendly methods of breeding;	5		V	V	
18	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							
19	Modern technologies of enrichment and processing of mineral raw materials and technogenic waste	Purpose: Basic knowledge and skills in the field of processing mineral and man-made raw materials, characteristic features of modern metal enrichment technologies, sources and main processes of processing mineral and man-made raw materials; as well as methods to increase metal extraction and reduce the cost of reagents, electricity and various materials will be presented. Content:As part of the course, the undergraduate will master theoretical and applied issues related to the field of modern technologies for the enrichment and processing of mineral raw materials and man-made waste containing various valuable metals.	5		V	V	V
20	Theory and practice of uranium ore and concentrates processing	Purpose: to gain knowledge in the field of enrichment and processing of uranium-containing mineral raw materials. Content: The material composition of uranium ores. The technology of processing uranium ores. The main stages of uranium production. Ore enrichment. Extraction of uranium from ores and concentrates by leaching. Processing of productive solutions. Sorption technology for processing productive solutions. Methods of concentration and separation of uranium from commercial desorbates. Environmental aspects of processing uranium ores and concentrates.	5		V	V	V
21	The theory of the separation of minerals in beneficiation processes	Purpose: The theoretical foundations, types and indicators of enrichment processes, patterns of separation of mineral particles in the working areas of concentrators and technological schemes, methods of modeling separation processes are considered. Content: The issues of separation of minerals in ore dressing processes are studied based on differences in the properties of the separated minerals. In this case, the difference in the physico-chemical properties of the surface of minerals is used, namely, the difference in their specific free surface energies, separating media and their properties.	5		V	V	V

22	Advanced mineral processing for eco-mining		5			V	V
23	Process wastewater concentrators	Purpose: to study the discipline, undergraduates have knowledge in the field of tailings processing plants, in particular in wastewater treatment processes, to understand the theory and practice of water neutralization from harmful toxic substances in order to return purified water to technological processes in the form of recycled process water. Content: The composition of wastewater from processing plants. Polluted and conditionally clean wastewater from processing plants. The composition of wastewater from gravity, gold recovery and flotation processing plants.	5			V	V
24	Design of modern production facilities for processing mineral and man-made raw materials	The purpose of the course: mastering the main aspects of designing modern production facilities for processing mineral and man-made raw materials Contents: General information about mineral and man-made raw materials as an object for industrial processing. The pre-design stage of designing modern production facilities for processing mineral and man-made raw materials. The design stage of designing modern production facilities for processing mineral and man-made raw materials. Working documentation. Course project.	6			V	V
25	Basics of granulation of dispersed materials	The purpose of the course: the formation of the ability to effectively control technological processes based on knowledge in the field of granulation of natural and technogenic raw materials. Description: mechanism of granulation; study of the compressibility of dispersed materials, their molding properties and the effect of heat treatment conditions on the chemical uniformity and structure of granules. Upon completion of the course, undergraduates will be able to perform calculations of the main characteristics of the technological process for obtaining granular materials; choose a rational scheme and evaluate production efficiency; apply modern research methods for the analysis and evaluation of the physico-chemical and technological properties of granular materials.	3			V	V
26	Technologies of silicate composite materials	The purpose of the course: the formation of a certain composition of competencies necessary for specialists to prepare for professional activities. Description: general ideas about composite materials and their properties; main trends in the development of composite materials. Upon completion of the course, undergraduates will have the skills to calculate the properties and design compositions of composite materials obtained on the basis of mineral and technogenic raw materials; perform calculations of the main characteristics of the technological process for obtaining composite materials, choose a rational scheme for the production of a given product.	3		V	V	V
27	Thickening and dehydration of mineral raw materials	The purpose of this discipline is to study the basic principles and technologies of thickening and dehydration of mineral raw materials, as well as their application in production practice. Content: During the training, students learn the basic methods and methods of dewatering and thickening of mineral raw materials, master the skills of working with appropriate equipment and carry out practical exercises at production sites.	5		V	V	
Cycle of profile disciplines Component of choice							

28	Filtration and drying of processed and enriched products	Purpose: The choice of the dewatering method depends on the characteristics of the material that is being dewatered, mainly granulometric and mineralogical compositions, its initial moisture content, as well as conditioning humidity requirements. Content: The discipline describes the parameters and properties of the phases of the flotation system and the main processes occurring during the interaction of phases in the volume of the liquid phase and on the mineral surface: hydration, dissolution and hydrolysis;	5	V	V		
29	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 strategic, project and operational management.					
30	Labor and environmental protection in mineral processing processes	The purpose of this discipline is to minimize risks to the health and life of employees, prevent accidents and emergencies, and comply with legal and regulatory requirements in the field of occupational safety and the environment. The content of the discipline includes the study of labor and environmental protection legislation, risk assessment and management methods, technical means of protecting employees, environmental standards and technologies, as well as planning and conducting training and control activities in this area.	5		V	V	V
31	Modern methods of designing mineral processing facilities	Purpose: to prepare a graduate student with an understanding of the scientific principles of the organization of technological design and construction of processing plants; Content: Problems of designing industrial enterprises; new methods of calculating technological schemes for various types of raw materials; modern methods of selection and calculation of main and auxiliary equipment; basic principles of equipment layout. the ability to use special, scientific, technical and advertising literature.	5			V	V
32	Surface chemistry flotation process	Purpose: To study the peculiarities of the course of chemical reactions in the liquid phase of the flotation pulp, taking into account the displacement of the equilibrium characteristics of ions and reagent molecules during their transition from the volume of the aqueous phase to the boundary layer. Contents: The parameters and properties of the phases of the flotation system and the main processes occurring during the interaction of phases in the volume of the liquid phase and on the mineral surface are described: hydration, dissolution and hydrolysis.	5		V	V	V
33	Theory and practice of processing of polymetallic ores	The purpose of this discipline is to develop effective technologies and processes for extracting valuable metals from raw materials with a high content of various metals. Content: the process of processing polymetallic ores includes several stages, starting from ore enrichment and processing to obtaining the final product. For the successful implementation of this process, many factors must be taken into account, such as the physico-chemical properties of the ore, technological features of the processing process,	5		V		V

		economic indicators and environmental aspects.					
34	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
35	Theory and practice of processing non-ferrous metal ores	The purpose of this discipline is to study the basic principles and technologies of processing non-ferrous metal ores, as well as to master practical skills in working with equipment and materials necessary for the production of high purity metals. The content of this discipline includes the study of basic methods of ore dressing, thermal and chemical treatment, various methods of separating metals from ores and concentrates, as well as the basics of designing and operating non-ferrous metal ore processing enterprises. Students also get acquainted with modern technologies and innovative methods in the field of enrichment and metallurgy of non-ferrous metals.	5			V	V
36	Technological features of technogenic raw materials	The purpose of the course: the formation of a certain composition of competencies for undergraduates to prepare for professional activities. Description: classification of sources of technogenic raw materials, technological assessment, technological features of processing. Upon completion of the course, the undergraduate will be able to assess the degree of danger of technogenic raw materials, a comparative analysis of technological solutions and develop measures to improve the efficiency of a particular method of processing technogenic raw materials; select and determine the optimal process modes, taking into account the characteristics of the material composition of raw materials; with the help of modern control tools, develop complex technological processes and schemes that reduce environmental risks.	3		V	V	V
37	Synthesis and kinetics of the processes of phase formation of silicate materials	The purpose of the course: the formation of the ability to apply the acquired skills, abilities and knowledge in solving practical problems in professional activities. Description: thermodynamic analysis of silicate formation reactions; kinetics of solid-phase processes; methods for the synthesis of solid-phase materials. Upon completion of the course, undergraduates will be able to integrate the acquired knowledge in relation to professional activities; carry out technical control and product quality management; plan scientific research in the field of synthesis of new silicate materials, taking into account the requirements of quality, safety and environmental friendliness; optimize the parameters of technological processes of silicate formation and develop highly efficient technologies and technological schemes.	3		V	V	V
38	Design thinking in Engineering	Design thinking as a phenomenon: concept, history, stages. Design thinking tools for The purpose of the course is to form a certain set of competencies necessary for specialists to prepare for professional activity. Course content: design thinking, its tools for designing a new product; world practices of using design thinking in engineering education; fundamentals of facilitation and critical	2	V	V	V	

		assessment of the work done. Upon completion of the course, undergraduates will be able to solve professional tasks at all stages of pre-design and project processes in design; apply project management methods, environmental risks; possess skills in planning and facilitating the work of the team; demonstrate management solutions to evaluate the results of the enterprise.					
39	Academic writing for scientific and professional purposes	Purpose: to develop students' practical knowledge, skills and abilities to work with various genres of scientific style, as well as writing original educational and scientific texts. Content: Writing an abstract for a scientific article. Writing a review. Writing a report. Writing various types of essays. Presentation of the research problem. A motivation letter. Preparation of the presentation. Business correspondence.	2		V		V
40	English language. Introduction to Professional Communication: Chemistry	The purpose of the course: the formation of professionally oriented foreign language communicative competence. Contents: chemical terminology is being studied: what is chemical engineering and chemical engineering facilities; careers in chemical engineering; materials in the chemical industry; technological process in the chemical industry: tools and equipment; chemical industry markets; safety at work; waste management and resource savings	2		V		V
41	Project management	The purpose of the course: an in-depth study of the basics of project management and the skills of a system organizer. Contents: introduction to project management; project planning, its goals and objectives; operational project management. Upon completion of the course, the undergraduate will be able to solve professional tasks based on knowledge of economic, organizational and managerial theory, innovative approaches, generalization and critical analysis of management practices; independently make informed organizational and managerial decisions, evaluate their operational and organizational effectiveness.	2			V	V
42	Hydro-mechanical processes and fundamentals of dewatering of mineral and man-made raw materials	The purpose of the course: the formation of a certain composition of competencies necessary for specialists to prepare for professional activities. Description of the course: moisture in materials; ways to remove moisture; processes and apparatus for dehydration and drying of mineral materials; advanced and combined methods of dehydration; compaction of mineral and technogenic raw materials. Upon completion of the course, undergraduates will perform calculations of the main characteristics of hydromechanical processes, control the technological process in accordance with technological documents, control and analyze the quality of raw materials and dehydration products	6		V	V	
43	Technologies of special cements and products based on them	The purpose of the course: an in-depth study of the basics of the production of cements and products based on them. Description: the basics of the process of hydration of binders and the formation of cement stone; types of cements, calculation of compositions of raw mixes and technological equipment. Upon completion of the course, the undergraduate will be able to solve engineering problems for optimizing processes; test and evaluate the properties of cements; carry out technological calculations and equipment design; perform work to ensure the control of the parameters of the technological process and the quality of the finished product, taking into account environmental safety, saving fuel and	6		V	V	

		energy resources.					
44	Promising directions of mineral raw material enrichment	Objective: to optimize the enrichment processes and increase the efficiency of mining. Content: the study of modern technologies for the enrichment of mineral raw materials, the analysis of promising research methods and the development of new enrichment methods, as well as the development of modern software systems for modeling and optimizing enrichment processes. All this allows students to study in depth the principles and methods of work in the field of mineral processing and prepare for professional activity in the mining industry.	6			V	V
45	Technologies of special types of ceramics	The purpose of the course: in-depth study of the manufacturing technology and properties of special ceramic materials and products. Description: features of the technology of ceramic materials from natural, synthetic and technogenic raw materials; physical and chemical foundations of the technology of fine and coarse (refractory and building) ceramics. Upon completion of the course, the undergraduate will know the current trends in the production of the most important types of ceramics and products; be able to solve various engineering problems; test and evaluate the properties of special types of ceramics; perform work to ensure quality control of parameters of the technological process and the quality of the finished products, taking into account environmental safety, saving fuel and energy resources.	6		V	V	V
46	Calculations and design of auxiliary equipment for processing mineral and man-made raw materials	The purpose of this course is to acquire the necessary knowledge and skills to develop effective technical solutions in the field of processing and processing of various types of raw materials. Contents: General principles and methodology of designing equipment in the industry. Calculation and design of shell-and-tube heat exchangers. Calculation and design of column mass transfer devices. Calculation and design of devices with mixing devices (APUs).	6		V	V	
47	Technologies of special glasses and glass products	The purpose of the course: an in-depth study of the manufacturing technology and properties of special glasses and products. Description: features of the technology of special glasses and products from natural and technogenic raw materials; physical and chemical bases of technology of glass and glass products. Upon completion of the course, the undergraduate will know the current trends in the production of the most important special types of glass and glass products; be able to solve various engineering problems; test and evaluate the properties of special types of glass; perform work to ensure quality control of parameters of the technological process and the quality of the finished products, taking into account environmental safety, saving fuel and energy resources.	6			V	V

5. Curriculum of the educational program

NJSC "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.

TWO-DEGREE EDUCATIONAL PROGRAM

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

Educational program 7M07226 - "Mineral processing"
Group of educational programs M118 - "Mineral processing"

Form of study: full-time Duration of study: 2 year Academic degree: Master of Technical Sciences

Discipline code	Name of disciplines	Cycle	Total amount in academic 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			
								1 course		2 course	
								1 semester	2 semester	3 semester	4 semester
CYCLE OF BASIC DISCIPLINES (BD)											
M-1. Module of basic training (university component)											
LNG213	Foreign language (professional)	BD UC	3	90	0/0/2	60	E	3			
HUM214	Management Psychology	BD UC	3	90	1/0/1	60	E	3			
HUM212	History and philosophy of science	BD UC	3	90	1/0/1	60	E		3		
HUM213	Higher school pedagogy	BD UC	3	90	1/0/1	60	E		3		
component of choice											
MET712	Ore preparation and pre-concentration	BD CCH	5	150	2/1/0	105	E	5			
MET255	Geotechnological methods of complex processing of mineral raw materials poor				2/1/0						
MET714	Theory and practice of processing of gold-containing raw materials	BD CCH	5	150	2/1/0	105	E	5			
MET266	Special chapters of the theory of flotation processes				2/1/0						
MNG781	Intellectual property and research				2/0/1						
MET253	Hardware and technological features of process of ore dressing	BD CCH	5	150	2/1/0	105	E			5	
MET254	Non-waste technology processing industry				2/1/0						
MNG782	Sustainable development strategies				2/0/1						
CYCLE OF PROFILE DISCIPLINES (PD)											
M-2. Module of professional activity (university component, component of choice)											
MET708	Modern technologies of enrichment and processing of mineral raw materials and technogenic waste	PD UC	5	150	2/0/1	105	E	5			
MET753	Theory and practice of uranium ore and concentrates processing	PD UC	5	150	2/1/0	105	E	5			
MET723	The theory of the separation of minerals in beneficiation processes	PD UC	5	150	2/1/0	105	E		5		
MEI240	Advanced mineral processing for eco-mining	PD UC	5	150	2/0/1	105	E		5		
MET262	Process wastewater concentrators	PD UC	5	150	2/1/0	105				5	
MET716	Thickening and dehydration of mineral raw materials	PD CCH	5	150	1/1/1	105	E		5		
MET717	Filtration and drying of processed and enriched products				1/1/1						
MNG705	Project Management				2/0/1						
MET729	Labor and environmental protection in mineral processing processes	PD CCH	5	150	2/0/1	105	E		5		
MET755	Modern methods of design of mineral processing facilities				2/1/0						
MET274	Surface chemistry flotation process	PD CCH	5	150	2/1/0	105	E			5	
MET267	Theory and practice of processing of polymetallic ores				2/1/0						
MEI241	Industrial waste management, resource recovery and recycling technologies	PD CCH	5	150	2/0/1	105	E			5	
MET269	Theory and practice of processing of non-ferrous metals				2/1/0						
M-3. Practice-oriented module											
AAP273	Pedagogical practice	BD UC	8							8	
AAP269	Research practice	PD UC	8								8
M-4. Experimental research module											
AAP268	Research work of a master's student, including internship and completion of a master's thesis	RWMS UC	4					4			
AAP268	Research work of a master's student, including internship and completion of a master's thesis	RWMS UC	4						4		

AAP251	Research work of a master's student, including internship and completion of a master's thesis	RWMS UC	2							2	
AAP255	Research work of a master's student, including internship and completion of a master's thesis	RWMS UC	14								14
	M-5. Module of final attestation										
ECA212	Preparation and defense of a master's thesis	FA	8								8
	Total based on UNIVERSITY:							30	30	30	30

Federal State Autonomous Educational Institution of Higher Education
National Research Tomsk Polytechnic University

Educational program "Processes and devices for processing mineral and man-made raw materials"
Direction of training 18.04.01 - "Chemical technology"

Form of study: full-time Duration of study: 2 year Academic degree: Master of Technical Sciences

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			
								1 course		2 course	
								1 semester	2 semester	3 semester	4 semester
CYCLE OF BASIC DISCIPLINES (BD)											
M1 Block 1. Disciplines (modules)											
M1.BM1 Module of general scientific disciplines											
MET271	Philosophical and methodological problems of science and technology	BD UC	3	108	1/0/1	76	Exam		3		
MET272	Professional training in English	BD UC	6	216	0/0/4	152	Cre	3	3		
M1.BM2 Module of general professional disciplines											
MET782	Modern processes and devices for processing mineral and man-made raw materials	BD UC	6	216	1/1/1	152	Exam	6			
MET783	Modern methods of scientific research in chemical technology	BD UC	3	108	1/1/1	60	Exam	3			
MET784	Physics and chemistry of nanomaterials	BD UC	3	108	1/1/1	60	Cre	3			
MET785	Planning and processing of experiments in chemical technologies	BD UC	3	108	1/1/1	76	Cre		3		
CYCLE OF PROFILE DISCIPLINES (PD)											
M1.VM1 Interdisciplinary Professional Module											
MET786	Design of modern production facilities for processing mineral and man-made raw materials	PD UC	6	216	1/1/1	136	Exam		6		
MET787	Basics of granulation of dispersed materials	PD UC	3	108	1/1/1	60	Cre			3	
MET788	Technological features of technogenic raw materials	PD CCH	3	108	1/1/1	60	Exam		3		
MET789	Synthesis and kinetics of the processes of phase formation of silicate materials										
MET790	Technologies of silicate composite materials	PD UC	3	108	1/0/1	76	Cre	3			
M1.VM2 Module of university-wide elective disciplines											
MET286	Design thinking in Engineering	PD CCH	2	72	1/0/1	40	Cre	2			
MET287	Academic writing for scientific and professional purposes										
MET288	English language. Introduction to Professional Communication: Chemistry										
MET769	Project management										
M1.VM3 Variable interdisciplinary professional module											
M1.VM3.1 "Processes and devices for processing mineral and man-made raw materials"											
MET791	Hydro-mechanical processes and fundamentals of dewatering of mineral and man-made raw materials	PD CCH	6	216	1/1/1	152	Exam			6	
MET792	Technologies of special cements and products based on them										
MET793	Promising directions of mineral raw material enrichment	PD CCH	6	216	1/1/1	168	Exam			6	
MET794	Technologies of special types of ceramics										
MET795	Calculations and design of auxiliary equipment for processing mineral and man-made raw materials	PD CCH	6	216	1/1/1	152	Exam			6	
MET796	Technologies of special glasses and glass products										
M2 Block 2. Dispersed practices, including research											
MET775	Pedagogical practice. Fundamentals of pedagogical activity	PD UC	1	36				1			
MET776	Pedagogical practice	PD UC	3	108					3		
MET777	Research work in the semester	PD UC	18	648				6	6	6	

M2 Block 2. Practices											
MET797	Practice on obtaining primary professional skills and abilities (educational practice)	PD UC	6	216					6		
MET798	Practice in obtaining professional skills and professional experience (including technological practice)	PD UC	9	324							9
MET780	Pre-graduate practice	PD UC	15	540							15
M3 Block 3. State final certification											
MET781	Master's final qualifying work (execution, preparation for the defense procedure and defense of the final qualifying work)	FA	9	324							9
	Total based on UNIVERSITY:							27	33	27	33

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		20	15	35
PD	Cycle of profile disciplines		33	20	53
	Total for theoretical training:	*0*	*53*	*35*	*88*
	RWMS		*24*		*24*
FA	Final attestation	8			8
	TOTAL:	8	77	35	120

Decision of the Academic Council of KazNRTU named after K.Satpayev. Protocol №12, 22.04.2024 y.

Decision of the Educational and Methodological Council of KazNRTU named after K.Satpayev. Protocol №6, 19.04.2024y.

Decision of the Academic Council of MaMI named after O. Baikonurov. Protocol №7, 27.03.2024y.

Vice-Rector for Academic Affairs — **R.K. Uskenbaeva**

Director of the Mining and Metallurgical Institute — **K.B. Rysbekov**

Head of department "Metallurgy and mineral processing" — **M.B. Barmenshinova**

Representative of the employers' council of the LLP "KAZ Minerals" — **U.K. Jetybaeva**