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

EDUCATIONAL PROGRAM

6B07213 – «Mineral Processing»

Code and classification of the field of education:	6B07-Engineering, manufacturing and construction industries
Code and classification of training areas:	6B072-Manufacturing and manufacturing industries
Group of educational programs:	B071-Mining and Quarrying
NRC level:	Level 6-higher education and practical experience
ORC Level:	Level 6 – a wide range of special (theoretical and practical) knowledge (including innovative ones). Independent search, analysis and evaluation of professional information
Duration of training:	4 years old
Loan:	240

Almaty 2023

The educational program «6B07213-Mineral Processing» was approved at the meeting of the Academic Council of KazNTU named after K. I. Satpayev.

Protocol № 5 dated "24" 11 2022.

The educational program «6B072 13-Mineral Processing» was developed by the Academic Committee in the direction of «Manufacturing and Processing industries»

Protocol № 3 dated "17" 11 2022.

The educational program «6B07213-Mineral Processing» was developed by the Academic Committee in the direction of «Manufacturing and Processing industries»

Full name	Academic degree/ academic title	Post	Place of work	Signature
Chairman of the Academic Committee:				
Barmenshinova M. B.	c.t.s., assoc.prof	Head of the Department of Metallurgy and mineral processing	KazNTU named after K.I. Satpayev	
Teaching staff:				
Motovilov I. Yu.	PhD	associate professor	KazNSTU named after K.I. Satpayev	
Employers:				
Jetybaeva U. K.	-	main concentrator	TOO "Kazminerals»	
Arinov A. K.	-	general manager	TOO "Goldstone Minerals»	
Students				
Smolkova A.I.	master	doctoral student 3 years of study	KazNSTU named after K.I. Satpayev	

Table of contents

List of abbreviations and symbols

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

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

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

EP – educational program;

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

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

WC – working curriculum;

CED – catalog of elective disciplines;

UC – university component;

CC – component of choice;

NQF – National Qualifications Framework;

IQF – Industry qualifications framework;

LO – learning outcomes;

KC – key competencies.

1. Description of the educational program

It is intended for the implementation of specialized bachelor's training under the "Mineral Processing" educational program at the K. I. Satpayev KazNRTU and was developed in the framework of the "Manufacturing and Processing Industries" direction.

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

- Law of the Republic of Kazakhstan "On Education" with amendments and additions in the framework of legislative changes to increase the independence and autonomy of higher education institutions of 04.07.18 No. 171-VI;
- Law of the Republic of Kazakhstan "On Amendments and additions to certain Legislative Acts of the Republic of Kazakhstan on expanding the academic and managerial independence of higher educational institutions" dated 04.07.18 No. 171-VI;
- Order of the Minister of Education and Science of the Republic of Kazakhstan dated 30.10.18 No. 595 "On approval of Standard Rules for the activities of relevant types of educational organizations";
- State mandatory standard of higher education (Appendix 7 to the Order of the Minister of Education and Science of the Republic of Kazakhstan No. 604 dated 31.10.18;
- Resolution of the Government of the Republic of Kazakhstan dated 19.01.12 № 111 "On approval of Standard rules for admission to study in educational organizations implementing educational programs of higher education" with amendments and additions dated 14.07.16 № 405;
- Resolution of the Government of the Republic of Kazakhstan dated 27.12.2019 No. 988 "On approval of the State Program for the Development of Education and Science of the Republic of Kazakhstan for 2020-2025";
– Resolution of the Government of the Republic of Kazakhstan dated 31.12.2019 No. 1050 "On approval of the State Program of Industrial and Innovative Development of the Republic of Kazakhstan for 2020-2025";
– "National Qualifications Framework" approved by the protocol of 16.06.2016 of the Republican Tripartite Commission on Social Partnership and Regulation of Social and Labor Relations;
– Industry qualification framework "Mining and Metallurgical Complex" No. 1 dated 30.07.2019.

Currently, the list of scarce and in-demand professions of the mining and metallurgical complex of Kazakhstan, along with professions that ensure the introduction of automated systems, robotics and digital technologies, includes the profession of "concentrator".

In the world practice of mining and processing of ores, the problem of depletion of mineral reserves or depletion of ore reserves is noted. Therefore, it becomes necessary to make technological adjustments to the methods of extraction

and enrichment of mineral raw materials in production. In addition, in the light of increasing environmental requirements for waste disposal, it is necessary to recycle tailings, sludge, and industrial waste. Here, a special role is assigned to the concentrator, who will have to master different types of technologies for processing and using man-made raw materials, determine the most effective one and apply it.

The "Mineral Processing" educational program includes fundamental, natural science, general engineering and professional training of bachelors in the field of ore and man-made raw materials processing in accordance with the development of science and technology, as well as the changing needs of the mining and metallurgical industry.

Graduates of the developed educational program have knowledge of technology about boore thickening ferrous, non-ferrous, precious, radioactive, rare and other metals, as well as processing of man-made raw materials.

Mission statement educational programs "Mineral Processing": preparation of bachelors-concentrators who know the mineral and raw material base, technologies of ore and technogenic raw materials processing, production technologies and areas of metal consumption, who have a fundamental training in physics, mathematics, chemistry, physical and chemical fundamentals of enrichment technologies and metallurgy carelessness students ' knowledge, skills and abilities that allow them to analyze problems in the field of professional activity. research activities and find ways to solve them, solve engineering problems of designing technologies and equipment of processing plants, conduct experimental research using information technologies and mathematical modeling.

Field of professional activity. Specialists who have completed a bachelor's degree perform production, technological and organizational work at industrial enterprises, as well as conduct research work on the enrichment of minerals, the production of mineral fertilizers, and the production of mineral fertilizers. ore concentrates ferrous, non-ferrous, rare and radioactive metals.

Objects of professional activity. The objects of professional activity of graduates are processing plants, enterprises of ferrous and non-ferrous metallurgy, chemical, mining and chemical and machine-building industries, branch research and design institutes, factory laboratories, secondary professional and higher educational institutions.

Subjects of professional activity these are technological processes of the mining and processing and metallurgical industries, processing of ore and man-made raw materials, etc concentrate emissions advanced consumer properties, mining and metallurgical production equipment, automatic control systems processing equipment production and quality control of final products.

Types of economic activity: screening machine operator, dosing machine operator, crushing machine operator, concentrator operator, mill operator, washing machine operator, roaster operator, concentration product controller, thickener apparatchik, filter operator, equipment maintenance and repair locksmith, aggregate repair locksmith, control panel operator, dryer, flotator, mineralogical analysis laboratory assistant.

2. The purpose and objectives of the educational program

Goal EP «Mineral Processing"it is aimed at training highly qualified, competitive and in-demand specialists in the labor market in the field of mineral and man-made raw materials processing for the mining and metallurgical complex of the Republic of Kazakhstan, have professional and personal competencies that allow you to: perform calculation and design, production and technological, research, organizational and managerial and entrepreneurial activities at processing plants and industrial facilities.

EP tasks «Mineral Processing»:

- study the cycle of general education disciplines to ensure social and humanitarian education based on the laws of socio-economic development of society, history, modern information technologies, the state language, foreign and Russian languages;
- study of the cycle of basic disciplines to ensure knowledge of natural science, general technical and economic disciplines, as the foundation of professional education;
- the cycle of specialized disciplines is focused on the study of key theoretical and practical aspects of ore and man-made raw material processing, rational use of natural resources;
- study of disciplines that form knowledge, skills and abilities of planning and organizing research, designing works in the field of mineral processing and man-made raw materials;
- familiarization with technologies and equipment of processing plants during various types of practical training.
- acquisition of skills in laboratory research, technological calculations, equipment selection and design using modern computer technologies and programs.

3. Requirements for the evaluation of learning outcomes of the educational program

B – basic knowledge, skills and abilities

B1 – study the modern history of the Republic of Kazakhstan, stages and prospects of state development;

B2 – with inability to use modern technologies to gain access to and exchange information sources. Possess the skills of working on a computer as a means of managing, storing and processing information and performing calculations using general and applied software products.

B3 – be proficient in the state language, Russian, and one of the most widely spoken foreign languages in the industry at a level that ensures 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 – ability to use knowledge and methods of general engineering disciplines (fundamentals of automation and mechanics) in practical activities.

B6-awareness in the field of financial analysis and project evaluation, project management and business, in the basics of macro-and microeconomics, knowledge and understanding of risks in market conditions.

B7 – familiarization with technological processes and skills of working in processing plants.

B8 – know and master the main business processes in an industrial enterprise.

P – professional competencies, including those that meet the requirements of industry-specific professional standards

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

P2 – proficiency in professional terminology and the ability to work with educational and scientific materials in the specialty in the original state, Russian and foreign languages. Ability to logically correct, well-reasoned, and clearly construct oral and written speech in three languages

P3 – knowledge of the requirements of Occupational Safety and Health Regulations at work and the ability to apply them in practice.

P4 – proficiency in professional safety culture; ability to identify hazards and assess risks in their field; knowledge of basic methods of protecting production personnel and the public from possible consequences of accidents, catastrophes, natural disasters and improving working conditions in the field of professional activity.

P5-willingness to apply professional knowledge to prevent and minimize negative environmental impacts in the workplace.

P6 – ability to use regulatory legal documents in their activities.

P7 – choose rational methods for processing ferrous and non-ferrous metal ores and man-made raw materials that meet the requirements of integrated technology, economics and ecology.

P8 – be able to understand the social significance of your future profession. Have knowledge of the formation and development of the mining and processing industry in Kazakhstan and current priority trends

P9 – to be able to combine the theory of problems and practice for solving engineering problems, to conduct balanced thermal, hydraulic, and aerodynamic calculations of processes and apparatuses, based on practical data.

P10 – be able to apply in practice the principles of rational use of natural resources and environmental protection.

P11 – be able to select measuring instruments in accordance with the required accuracy and operating conditions.

P12 – be able to implement and adjust technological processes in the enrichment of mineral and man-made raw materials.

P13 – be able to identify objects for improvement in engineering and technology.

P14 – the ability to identify processing and metallurgical apparatuses and systems for transporting melts (reagents, pulps, etc.) that have low efficiency, an increased level of danger, and determine the necessary measures to improve the equipment and/or production technology.

P15 – be able to apply the methods of technical and economic analysis. Calculate and analyze chemical and physico-chemical processes, mass transfer processes occurring in the technological processes of processing (enrichment) of mineral raw materials.

P16 – be able to choose research methods, plan and conduct the necessary experiments, interpret the results and draw conclusions.

P17-Calculate and analyze hydrometallurgical processes and apparatuses, select optimal technological modes.

P18 – have the ability to analyze and synthesize. Conduct literary and analytical reviews.

P19 – be able to use the basic concepts, laws and models of thermodynamics, chemical kinetics, heat and mass transfer. Be able to select and apply appropriate modeling methods for physical, chemical, and technological processes.

P20 – be able to perform project elements.

P21-independently perform: calculations of equipment; drawings of parts and structural elements; calculations for strength and rigidity; calculations of machine parts and mechanisms; choose electrical equipment and calculate its operating modes; offer an automation system for the main equipment.

P22 – be able to justify the choice of equipment for the implementation of technological processes.

P23-conduct a feasibility study of processing processes. Plan the volume of production and perform calculations of production and sales costs, determine break-even conditions. Carry out approximate calculations of harmful emissions

and assess the environmental status of existing and projected technological processes and aggregates.

P24 – independence: performing independent work in typical situations and under guidance in difficult situations of professional activity; independent organization of training. Responsibility: for the results of work performed; for your own safety and the safety of others; for meeting environmental protection requirements and fire safety. Complexity: solving typical practical tasks; choosing a method of action from known ones based on knowledge and practical experience: conducting the main technological process in accordance with your field of professional activity.

O – universal, social and ethical competencies

O1-take care of the environment in your work and daily life.

O2-consider ethical and legal norms in interpersonal communication, knowledge and understanding of your rights and obligations as a citizen of the Republic of Kazakhstan.

O3 – ability to critically generalize, analyze and perceive socio-political information using the basic laws of social development in solving social and professional problems, the ability to analyze socially significant problems and processes in society. Possess the culture and logic of thinking, an understanding of the general laws of social development and the ability to analyze them.

O4-awareness of the need and acquisition of the ability to independently learn and improve their skills throughout their work.

O5-understanding and practical use of healthy lifestyle standards, including prevention to improve performance

O6 – ability to build interpersonal relationships and work in a group (in a team).

C – special and managerial competencies

C1-independent management and control of the processes of work and educational activities within the framework of the strategy, policy and goals of the organization, discussion of the problem, reasoning of conclusions and competent operation of information;

C2 – independence: executive and managerial activity for the implementation of tasks under management, which provides for the independent definition of tasks, organization and control of its implementation by subordinate employees. Responsibility: for the results of implementing the norm; for your own safety and the safety of others; for meeting the requirements for environmental protection and fire protection. safety. Complexity: solving various typical practical tasks that require independent analysis of work situations. Conducting the main technological process in the field of their professional activities, various levels of complexity, mentoring in a team. Quality control of technological processes and finished products.

C3 – independence: atmanagement activity within the technological process section and the company's business strategy. Responsibility: for the evaluation and improvement of their own work, their own training and the training of others; for their own safety and the safety of others; for meeting environmental protection

requirements and fire safety. Complexity: solving practical problems based on the choice of ways to solve them in various changing working conditions. Organization of the production process, development and implementation of new equipment, technologies and assortment, organizational and managerial work to improve the quality of products and production efficiency of the mining and processing industry.

C4 – independence: management activity within the framework of the company's business strategy, which involves coordinating work with other sites. Responsibility: for planning and developing business processes that may lead to significant changes or developments, and responsibility for improving the professionalism of employees. Complexity: an activity aimed at solving problems that involve a choice and variety of ways to solve them. Conducting research and experimental work, designing the expansion and modernization of production, expanding and updating the range of the mining and metallurgical industry, introducing new technologies.

Special requirements for university graduation for this OP:

– the student should have a general understanding of the thesis topic / research plans, and contact potential academic supervisors one year before the expected completion of their studies;

– to get acquainted with potential academic supervisors and speed up students ' choice of topics for their thesis (project), a review meeting is held one year before the expected completion of their studies;

– to collect the necessary data and study current tasks, methods and procedures on the topic of the thesis, the student passes an industrial internship;

– upon completion of the internship, the student contacts the supervisor in writing or orally and informs about the results of the work, but no more than one week after the start of the 4th year of study;

– within 4 weeks after the start of their studies, the student and the supervisor must discuss and decide on the type (research, project or independent study) and topic of the thesis. This is an extremely important discussion and decision, as it is impossible to further change the topic and type of work.;

- the topic of the thesis (project) and the supervisor are assigned to the student or group of students no more than six weeks after the beginning of the final year of study and approved by the order of the rector of the higher educational institution.

4. Passport of the educational program

4.1. General information

№	Field name	Note
1	Code and classification of the field of education	6B07-Engineering, manufacturing and construction industries
2	Code and classification of training areas	6B072 – Manufacturing and processing industries
3	Group of educational programs	B071 – Mining and Mining
4	Name of the educational program	Mineral Processing
5	Brief description of the educational program	The educational program 6B07213 - " Mineral processing "(code according to the classifier of specialties of higher and postgraduate education of the Republic of Kazakhstan 2009 5B073700 – "Mineral processing") includes fundamental, natural science, general engineering and professional training of bachelors in the field of ore and technogenic raw materials processing in accordance with the development of science and technology, as well as the changing needs of the mining and metallurgical industry industries.
6	OP Goal	training of highly qualified, competitive and in-demand specialists in the field of mineral and man-made raw materials processing for the mining and metallurgical complex of the Republic of Kazakhstan, who have professional and personal competencies that allow performing calculation and design, production and technological, research, organizational and managerial and entrepreneurial activities at processing plants and industrial facilities.
7	Type of EP	New
8	NQF level	Level 6-higher education and practical experience
9	ORC Level	Level 6 – a wide range of special (theoretical and practical) knowledge (including innovative ones). Independent search, analysis and evaluation of professional informationм
10	Distinctive features of the EP	no
11	List of educational program competencies:	Professional competencies; Research competencies; Basic competencies and knowledge; Communication skills; Universal competencies; Cognitive competencies; Creative competencies; Information and communication skills.
12	Learning outcomes of the educational program:	LO1 - apply knowledge of mathematics, science and technology to solve professional problems. LO2 - be able to plan and conduct experiments, as well as analyze and interpret experimental data to develop optimal solutions. LO3 - have the skills to design technological processes for processing mineral and man-made raw materials in order to

		achieve the set goals within realistic constraints. LO4 - have the skills to work in interdisciplinary teams. LO5 - be able to identify, formulate and solve technical problems in the processing of non-ferrous, ferrous and precious metal ores, non-metallic and uranium-containing raw materials, and man-made waste. LO6-understand professional and ethical responsibility in the process of working in labor communities. LO7 - have effective communication skills in professional and public organizations. LO8-understand the consequences of technical and technological decisions in the processing of non-ferrous, ferrous and precious metal ores, non-metallic and uranium-containing raw materials, and man-made waste in a global, economic, environmental and social context. LO9 - the need for lifelong learning and learning on your own. LO10 - be able to analyze current problems and determine the principles of improving technological processes in the processing of mineral and man-made raw materials. LO11 - be able to use the methods, skills and modern engineering tools necessary for engineering practice.
13	Form of training	Full-time job
14	Duration of training	4 years old
15	Loan volume	240
16	Languages of instruction	Kazakh/Russian
17	Academic degree awarded	Bachelor of Engineering and Technology
18	Developer(s) and authors:	Barmenshinova M. B. Dyusenova S. 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	Number of credits	Generated learning outcomes (codes)										
				LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9	LO10	LO11
Cycle of general education disciplines Required component														
1	Foreign language	English is a discipline of the general education cycle. After determining the level (according to the results of diagnostic testing or IELTS results), students are divided into groups and disciplines. The name of the discipline corresponds to the level of English proficiency. During the transition from level to level, the prerequisites and post-prerequisites of disciplines are observed.	10	V										
2	Kazakh (Russian) language	Kazakh (Russian) language. The socio-political, socio-cultural spheres of communication and functional styles of the modern Kazakh (Russian) language are considered. The course highlights the specifics of the scientific style in order to develop and activate professional and communicative skills and abilities of students. The course allows students to practically master the basics of scientific style and develops the ability to perform structural and semantic analysis of the text.	10	V										
3	Physical Culture	The purpose of the discipline is to master the forms and methods of forming a healthy lifestyle within the framework of the vocational education system. Familiarization with the natural-scientific foundations of physical education, possession of modern health technologies, basic methods of independent physical education and sports. And also as part of the course, the student will master the rules of judging in all sports.	8	V										
4	Information and communication technologies (in English)	The task of studying the discipline is to acquire theoretical knowledge about information processes, about new information technologies, local and global computer networks, methods of information protection; to acquire skills in using text editors and tabular processors; to create databases and various categories of application programs.	5				V							
5	History of Kazakhstan	The purpose of the discipline is to provide objective historical knowledge about the main stages of the history	5		V									

		of Kazakhstan from ancient times to the present day; to acquaint students with the problems of the formation and development of statehood and historical and cultural processes; to promote the formation of humanistic values and patriotic feelings in the student; to teach the student to use the acquired historical knowledge in educational, professional and everyday life; to assess the role of Kazakhstan in world history.													
6	Philosophy	The purpose of the discipline is to teach students the theoretical foundations of philosophy as a way of cognition and spiritual development of the world; developing their interest in fundamental knowledge, stimulating the need for philosophical assessments of historical events and facts of reality, assimilating the idea of unity of the world historical and cultural process while recognizing the diversity of its skills of applying philosophical and general scientific methods in professional activity.	5				V								
7	Module of socio-political knowledge (sociology, political science)	The objectives of the disciplines are to provide students with explanations on the sociological analysis of society, about social communities and personality, factors and patterns of social development, forms of interaction, types and directions of social processes, forms of regulation of social behavior, as well as primary political knowledge that will serve as a theoretical basis for understanding socio-political processes, for the formation of political culture, the development of personal position and a clearer understanding of the measure of their responsibility; to help master the political-legal, moral-ethical and socio-cultural norms necessary for activities in the interests of society, the formation of personal responsibility and personal success.	3				V								
8	Module of socio-political knowledge (cultural studies, psychology)	The purpose of the disciplines is to study the real processes of cultural activity of people who create material and spiritual values, to identify the main trends and patterns of cultural development, the change of cultural epochs, methods and styles, their role in the formation of a person and the development of society, as well as to master psychological knowledge for the effective organization of interpersonal interaction, social adaptation in the field of their professional activities.	3			V									

Cycle of general education disciplines Component of choice															
9	Fundamentals of anti-corruption culture and law	The course introduces students to the improvement of socio-economic relations of Kazakhstan society, psychological features of corrupt behavior. Special attention is paid to the formation of an anti-corruption culture, legal responsibility for acts of corruption in various spheres. The purpose of studying the discipline "Fundamentals of anti-corruption culture and law" is to increase public and individual legal awareness and legal culture of students, as well as the formation of a knowledge system and a civic position on combating corruption as an antisocial phenomenon. Expected results: to realize the values of moral consciousness and follow moral norms in everyday practice; to work on improving the level of moral and legal culture; to use spiritual and moral mechanisms to prevent corruption.	5			V								
10	Fundamentals of economics and entrepreneurship	The discipline studies the fundamentals of economics and entrepreneurship from the point of view of science and law; features, problematic aspects and prospects of development; theory and practice of entrepreneurship as a system of economic and organizational relations of business structures; readiness of entrepreneurs for innovative receptivity. The discipline reveals the content of entrepreneurial activity, career stages, qualities, competencies and responsibilities of an entrepreneur, theoretical and practical business planning and economic expertise of business ideas, as well as risk analysis of innovative development, introduction of new technologies and technological solutions.	5			V								
11	Fundamentals of scientific research methods	The purpose of the discipline Fundamentals of Scientific research methods is the formation of students' skills and abilities in the field of methodology of scientific cognition. A brief description of the discipline. Methodological foundations of scientific knowledge. The concept of scientific knowledge. Methods of theoretical and empirical research. Choosing the direction of scientific research. Stages of research work. Research topic and its relevance. Classification, types and tasks of the experiment. Metrological support of experimental studies. Computational experiment. Methods of	5			V								

		processing the results of the experiment. Registration of the results of the study. Presentation of a research paper.												
12	Ecology and life safety	The discipline studies the problems of ecology as a science, ecological terms, the laws of the functioning of natural systems and aspects of environmental safety in working conditions. Environmental monitoring and management in the field of its safety. Sources of pollution of atmospheric air, surface, groundwater, soil and ways to solve environmental problems; life safety in the technosphere; natural and man-made emergencies	5			V								
Cycle of basic disciplines University level component														
13	Math I	The course is designed to study the basic concepts of higher mathematics and its applications. The main provisions of the discipline are used in the study of all general engineering and special disciplines taught by graduate departments. The course sections include elements of linear algebra and analytical geometry, an introduction to analysis, differential calculus of a function of one and several variables. The questions of methods for solving systems of equations, the application of vector calculus to solving problems of geometry, mechanics, physics are considered. Analytical geometry on the plane and in space, differential calculus of functions of one variable, derivative and differentials, study of the behavior of functions, Directional derivative and gradient, extremum of a function of several variables.	5	V										
14	Matematika II	The discipline is a continuation of Mathematics I. The sections of the course include integral calculus of a function of one variable and several variables, series theory. Indefinite integrals, their properties and methods of their calculation. Definite integrals and their applications. Improper integrals. Theory of numerical series, theory of functional series, Taylor and Maclaurin series, application of series to approximate calculations.	5		V									
15	Physics	The course studies the basic physical phenomena and laws of classical and modern physics; methods of physical research; the influence of physics as a science on the development of technology; the relationship of physics with other sciences and its role in solving scientific and technical problems of the specialty. The	5	V										

		course covers the following sections: mechanics, mechanical harmonic waves, fundamentals of molecular kinetic theory and thermodynamics, electrostatics, direct current, electromagnetism, geometric optics, wave properties of light, laws of thermal radiation, photoelectric effect.												
16	Engineering and Computer graphics	The discipline is aimed at studying the methods of object image and general rules of drawing, using computer graphics; studying the basic principles and geometric modeling approach and methodology for developing applications with a graphical interface; developing skills in the use of graphic systems for the development of drawings, using 2D and 3D modeling methods	5	V										
17	General Chemistry	Purpose: formation of knowledge on fundamental issues of general chemistry and skills of their application in professional activity. Summary of the laws, theoretical provisions and conclusions that underlie chemical disciplines; properties and relationships of chemical elements based on the periodic law of D.I.Mendeleev and on modern ideas about the structure of matter; fundamentals of chemical thermodynamics and kinetics; processes in solutions; structure of complex compounds.	5		V									
18	Physical Chemistry	The course physical chemistry allows students to form the ability to understand the physico-chemical essence of processes and use the basic laws of physical chemistry in complex production and technological activities. In the course of training, the student studies the laws of thermodynamics; basic equations of chemical thermodynamics; methods of thermodynamic description of chemical and phase equilibria in multicomponent systems; properties of solutions; fundamentals of electrochemistry; basic concepts, theories and laws of chemical kinetics and catalysis.	5			V								
19	Automation Basics	The discipline studies basic measuring instruments, primary converters (sensors) of technological parameters, actuators, microcontrollers and automatic control systems of machine tools and technological equipment. Describes the elements of automation systems, time and frequency characteristics of typical links, criteria for the study of linear systems for stability and methods for assessing the quality of the process.	5					V						

20	Technological mineralogy	General information about mineralogy. Formation of minerals in nature. Basic concepts about crystals. Properties of minerals and their classification. The properties of minerals used in the processing of various mineral raw materials for the production of metals have been studied. Concepts of minerals and deposits. Mineral deposits of the Republic of Kazakhstan.	4	V										
21	Fundamentals of Mineral Processing (in English)	The purpose of the discipline is to study by students the ways of preparing mineral raw materials for its primary processing and the main methods of mineral enrichment.	6			V								
22	Ore preparation processes and equipment	Ore preparation is widely used in the processes of processing ores of ferrous and non-ferrous metals, rare metal and gold-containing raw materials, as well as non-metallic raw materials, construction materials and other areas of the national economy of the Republic of Kazakhstan. In this course, the technological processes of ore preparation and enrichment, the design of the equipment used, methods of calculation and selection of main and auxiliary equipment, operation of crushing and grinding equipment are studied in detail.	5				V							
23	Metrology and standardization in the processing industry	The purpose of the discipline is to develop knowledge and practical skills of future bachelors in the use and compliance with the requirements of complex systems of general technical standards, performing precision calculations and metrological support in enrichment production, studying the basic provisions of the theory of metrology and metrological support, the principles of interchangeability of products according to geometric parameters, the practice of establishing tolerances and landings, the practice of technical measurements, the basic concepts of standardization and metrology to achieve high product quality with high labor efficiency.	5					V						
24	Gravity-based enrichment methods	In this course, the following are studied in detail: Theoretical foundations of gravity enrichment; Hydraulic and pneumatic classification processes and apparatuses; Enrichment in heavy media; Enrichment by jigging; Enrichment in a stream of water flowing along an inclined surface; Pneumatic enrichment; Ore washing.	5					V						
25	General Metallurgy (in English)	This course is an introductory part of metallurgy and helps the student to master the basic terms and definitions in metallurgy, the general principles of the development	5					V						

		of technological processes, as well as the structures and principles of operation of the main metallurgical units.												
26	Chemistry of Flotation Reagents (in English)	The discipline studies the theoretical foundations of changes in the surface properties of minerals, the role of crystal structure features and types of interatomic bonds in this, the effect of isomorphic impurities on the flotation properties of minerals, the appearance of anode and cathode sites on the surface, the role of crystal energy in adsorption processes, semiconductor properties of minerals, mineral solubility, chemisorption and molecular adsorption, bond strength of adsorbed ions with the elements of the crystal lattice, the change in surface energy at the solid-liquid boundary, hydrophobization and hydrophilization of the surface.	4					V						
27	Power supply and electrical equipment of processing plants	The main purpose of the discipline "Power supply and electrical equipment of concentrating factories" is to form students' solid knowledge in the field of principles of construction of power supply of concentrating factories: the study of external power supply, power sources and methods of transmission of electric energy, the main energy indicators of the energy economy. The importance of the discipline is that it introduces students to the normalization of illumination and the competent application of knowledge in the calculation of electrical loads and determining the power of transformer substations.	5						V					
Cycle of basic disciplines Component of choice														
28	Magnetic and special enrichment methods	Magnetic properties of minerals, Theory of magnetic fields of magnetic separators. Classification of magnetic separators. The structure and dynamics of movement of mineral particles in them. The practice of using magnetic separators and auxiliary devices. Obtaining artificial concentrates from mineral raw materials that cannot be enriched. Combined mineral processing processes (a combination of enrichment processes and metallurgical operations). Fine-tuning of substandard concentrates.	5			V								
29	Processing of gold-bearing ores and man-made raw materials	Characteristics of gold-bearing ores and technogenic raw materials. General characteristics of technological processes. Gravity-flotation technologies. Hydrochemical processes of ore and concentrate processing.	5			V								

		Pyrometallurgical processes of processing concentrates. Refining processing of gold-containing materials. Neutralization of enrichment wastewater and gold leaching solutions.													
30	Hydroaeromechanics of concentrating processes	The discipline studies the physical properties of liquids and gases, the basics of hydrostatics and hydrodynamics, the laws of motion of bodies in the medium, free and constrained motion, the equation of motion of bodies, fluid motion through granular and porous layers, fluid dynamics of fluidized layers, filtration through porous partitions, two and three-phase systems, suspensions, hydroaeromechanical processes occurring during the enrichment of minerals, aeration and mixing of suspensions	5				V								
31	Coal processing	Technological characteristics of coals and evaluation of the results of their enrichment. Methods and processes of coal enrichment. Enrichment of coking coals. Enrichment of energy coals. Enrichment of brown coal and oil shale. Complex use of mineral and organic components of coals. Coal-processing plants. Environmental protection.	5				V								
32	Coal processing	The course examines the theoretical foundations of processes, describes the design of standard devices and methods of their calculation, highlights the issues of maintenance of devices.	5					V							
33	Auxiliary facilities in OPI	The discipline studies the devices and operation of water supply devices, air supply, transportation of products at processing plants, the theoretical foundations of dewatering and dust collection processes, the design and principle of operation of devices used for drainage, centrifugation, thickening, filtration, drying and dust collection. Methods for the selection and calculation of the main auxiliary equipment and dehydration schemes are considered. The relationship of the auxiliary economy with the technological processes of enrichment. Methods of calculations and selection of auxiliary equipment, as well as the structure of the auxiliary economy.	5					V							
34	Automation of production processes at processing plants	The course provides for the study of the following main topics for mastering the discipline of enrichment automation: -concepts of control objects, control systems; -methods of measuring the main technological variables of enrichment processes (temperature, flow, level,	5						V						

		pressure, concentration of substances, PH measurement of solutions, conductometry, etc.); -creation of automated process control systems (automated control systems), purpose and composition of automated control systems, types of automated control systems; -mathematical models of objects, mathematical models of typical flows and kinetics of homogeneous and heterogeneous chemical reactions; -experimental determination of the properties of objects, acceleration curve, transients.												
35	Flotation reagents in OPI	Basic theories of flotation in its current state. The methods of investigation of the action of flotation reagents and the mechanism of the flotation process, as well as the processing of the results obtained, are described in detail. The fundamentals of the theory and practice of the use of flotation reagents in the flotation of ores of non-ferrous and related rare metals are described. The structure and composition, physical and chemical properties of the reagents are described.	5						V					
36	Theory and practice of hydrometallurgical processes	Fuel combustion. Physico-chemical laws of reactions of gorenje gases and gasification of carbon. Carbonates and oxides formation and thermal dissociation. Regularities of formation and thermal dissociation of oxides and carbonates. Reduction of metal oxides. Theory of reduction of oxides by gaseous reducing agents and solid carbon. Thermodynamics and kinetics of metallurgical melts. Thermodynamics and kinetics of the behavior of harmful impurities. Theoretical foundations of processes occurring during oxidative refining, desulfurization, deoxidation and degassing of iron melts.	5						V					
37	Development of innovative equipment in enrichment	New designs of crushers for the modernization of the crushing process. Prospects for technical re-equipment of screening units of processing plants. Modernization of technological processes of ore preparation. A new generation of highly efficient screens for bulk materials and pulps. Knelson gravity technologies. Intensification of the deposition process. Modern equipment for magnetic enrichment methods. New generation flotation machines. Intensification of the dewatering process by upgrading disk vacuum filters.	5						V					
38	Technologies for processing non-ferrous metal ores	Raw material base of non-ferrous metallurgy. Technology of preparation of non-ferrous metal ores. The importance	6							V				

		of ore quality management during enrichment. Comparative characteristics of pre-concentration methods in the enrichment of non-ferrous metal ores. Schemes of enrichment of ores of non-ferrous metals. Technological schemes and modes of enrichment of copper ores. Polymetallic ore enrichment schemes. Polymetallic ore enrichment modes												
39	Reagent economy of concentrating plants	Reagent economy of processing plants. Warehouses of dry and liquid reagents and oils. Reagent department. Dosing platforms. Equipment for preparation and dosage of reagents.	6							V				
Cycle of profile disciplines University level component															
40	Tailings management and wastewater treatment	Classification of waste. Methods and places of waste storage. Chemical and mineralogical composition of waste. Current and stale tailings of processing plants. Methods of processing stale tailings of processing plants (gravity, flotation, special and combined methods). Waste obtained during the enrichment of sulfide, oxidized and other ores. Processing of slag from metallurgical plants. Promising technologies for the processing of solid household waste.	5							V				
41	Testing and control of processing processes	Basic concepts about the process of testing minerals, products of their enrichment, control of technological processes at processing plants. The list of controlled parameters. The minimum mass of the sample for analysis: chemical, granulometric, fractional. Sample preparation. Control of enrichment processes. Technological and commodity balance. Organization of testing and control.	5							V				
42	Operation and repair of processing equipment	The discipline studies the devices and operation of water supply, air supply, transportation of products at processing plants, bunker farming, storage of raw materials and enrichment products. The interrelation of auxiliary economy with technological processes of enrichment is considered. Methods of calculations and selection of auxiliary equipment, as well as the structure of the auxiliary economy are studied	6							V				
43	Fundamentals of mining technology	Features of extraction of solid minerals by open and underground methods. Preparation of rocks for excavation (drilling and blasting), excavation and loading	5				V							

		operations, transportation of ore and waste rocks, dumping and warehousing. Averaging and loading complexes. Methods of intra-quarry averaging of ore.													
44	Flotation methods of enrichment	The physicochemical foundations of the flotation process are considered. The reasons for the appearance of free energy at the interphase boundaries. The use of flotation reagents to regulate energy changes at phase boundaries. Adsorption processes on the phase sections. Classification of flotation reagents and their role in flotation. The mechanism of action of reagents. Flotation machines, features of their designs and applications. Flotation schemes of enrichment. Brief information about the use of reagents in flotation enrichment of various types of ores.	4						V						
Cycle of profile disciplines Component by to your choice															
45	Processing of polymetallic ores	Non-ferrous metal ores are a complex raw material and a source of obtaining not only non-ferrous, but also rare, noble, rare earth metals, sulfur, barite, fluorite, quartz, feldspar and other elements, and minerals that are extremely necessary for various sectors of the national economy of the Republic of Kazakhstan. The course is devoted to the study of a variety of technological schemes, reagent modes and methods of polymetallic ore enrichment.	5						V						
46	Technologies for processing uranium-containing ores and concentrates	Mechanical processing of uranium ores. Acid and carbonate leaching of uranium ores. Underground leaching of uranium. The phenomenon of colmatation of wells. Thickening. Sorption method of uranium concentration. Classification of ion-exchange materials and basic requirements for ionites. Regeneration of a sorbent saturated with uranium. Fundamentals of the process of extraction purification of uranium compounds. Sedimentary methods for obtaining a chemical concentrate of natural uranium. Filtering. Drying and calcining.	5						V						
47	rocessing of rare metal ores	Types and deposits of rare ores. Preliminary enrichment of ores and placers of rare metals. Ore preparation operations in the processing of ores and placers of rare metals. Technology of enrichment and integrated use of the main types of ores and placers (tungsten and tungsten-	4						V						

		molybdenum, tin and tin-polymetallic ores, titanium-zirconium ores and placers, tantalum-niobium ores and placers, etc.).													
48	Dewatering and dust collection	The discipline studies the theoretical foundations of dewatering and dust collection processes, the design and principle of operation of devices used for drainage, centrifugation, thickening, filtration, drying and dust collection. Methods for the selection and calculation of the main auxiliary equipment and dehydration schemes are considered.	4						V						
49	Modeling of concentrating processes	Methods of making models of enrichment processes. Obtaining high technological indicators by performing experiments using mathematical planning methods. Preparation of planning matrices, estimation of experimental variance, determination of the adequacy of the obtained model and its application. General issues of modeling production systems. Application of theoretical relations and statistical methods for mathematical description of enrichment processes.	6							V					
50	Geotechnical methods of enrichment	The discipline studies methods of geotechnological extraction of minerals, in order to determine the possibility of transferring extracted useful components to a mobile state. The issues of physico-chemical bases of geotechnological processes are considered. The schemes of geotechnological processing of uranium, gold, manganese, iron ores and non-metallic minerals are studied, and the processes of processing geotechnical products are also considered.	6							V					
51	Processing of mining, chemical and non-metallic raw materials	The discipline deals with the processing of mining and chemical raw materials, the equipment used, the principles of choosing processing schemes and evaluating technical and economic indicators, analyzing the material and mineralogical composition of ore to choose the most effective technological scheme of enrichment. General information about mining and chemical raw materials and raw materials base is given. Consumer requirements for enrichment products. The current state in the field of enrichment and processing, prospects for further development of this branch of production.	5								V				
52	Underground ore leaching technology	Physico-chemical bases of the processes of dissolution of metals during leaching. Natural properties of raw	5								V				

		materials used in leaching. Preparation of raw materials for the leaching process. Heap and underground leaching of metals. Processing of productive solutions, bacterial-chemical underground and heap leaching. Prospects for the development and use of leaching processes. Environmental aspects of heap and underground leaching technology. Underground leaching is used to process the mined areas of copper deposits by special pouring of acid solutions. Leaching solutions are directed to the extraction of copper by cementation.												
53	Magnetic and electric enrichment methods	Magnetic and special methods of enrichment, ore-picking of mineral raw materials (manual and automatic) to improve the quality of raw materials and extract valuable minerals. Mineral raw materials that cannot be enriched and methods of its processing using combined processes (enrichment and metallurgy). Finishing of concentrates conditioned by the base metal, but defective by impurities. Processing of collective concentrates obtained by enrichment methods using pyro- and hydrometallurgical operations.	5									V		
54	Processing of ferrous metal ores	The material composition of ore raw materials. Theoretical foundations and features of the enrichment of various ferrous metal ores. Principles and conditions of separation of ore minerals from aggregates with non-metallic minerals, ore enrichment and its definition. Classification of methods and processes of ore enrichment based on separating forces. Schemes and devices for the enrichment of magnetite, titanomagnetite and other ores of complex composition, oxidation of iron ores and quartzites, brown iron ore, manganese and chromium ores, carbonate iron and manganese ores. Experience of factories for the enrichment of ferrous ores. Ways of complex use of mineral raw materials of ferrous metals.	5									V		
55	Special and combined methods of enrichment	Special methods of enrichment, ore-picking of mineral raw materials (manual and automatic) to improve the quality of raw materials and extract valuable minerals. Mineral raw materials that are not amenable to enrichment and methods of its processing with the use of combined processes (enrichment and metallurgy). Finishing of concentrates conditioned by the base metal,	5										V	

		but defective by impurities. Processing of collective concentrates obtained by enrichment methods using pyro- and hydrometallurgical operations.													
56	Fundamentals of scientific research in ore dressing	The discipline studies the problems of organizing and staging scientific research, the choice of the topic of scientific work, the stages and content of scientific research, the principles of selecting information on the topic of scientific research, planning and staging an experiment, requirements for publication materials, registration of patent documentation, presentation of scientific results and a report on the topic of research. Acquaintance with the biography of scientists of Kazakhstan and the CIS, the role of scientific research in the formation and development of the enrichment industry.	5											V	
57	Ore concentration testing	The discipline studies methods of sampling technological samples, preparing them for research on enrichment, drawing up schemes for cutting samples, the material and mineralogical composition of ore using various methods of analysis, the use of planning experiments, the methodology of conducting circuit experiments, the procedure for conducting semi-industrial and industrial tests, the methodology for compiling research reports.	4												V
58	Industrial water supply, transport and tailings facilities of	Classification of waste. Methods and places of waste storage. Chemical and mineralogical composition of waste. Current and stale tailings of processing plants. Methods of processing stale tailings of processing plants (gravity, flotation, special and combined methods). Waste obtained during the enrichment of sulfide, oxidized and other ores. Processing of slag from metallurgical plants. Promising technologies for the processing of solid household waste.	4												V
59	Design of processing plants	The discipline studies general information about the design and design of mining and metallurgical enterprises, initial data for design, selection and justification of qualitative indicators of enrichment and productivity of factories and individual workshops. Selection and calculation of technological and water-sludge enrichment schemes, selection and calculation of main and auxiliary equipment. Organization of design of buildings and structures, general principles of equipment	5												V

		layout. Repair, storage and tail facilities, master plan. CAD elements in the design of processing plants.													
60	Digitalization of mining and processing plants	The role of digital technologies in improving the economic management mechanism in the mining and processing industry. Complex tasks related to the processing of ore and man-made raw materials can be controlled by intelligent analytical software packages and controlled in an integrated way, which will allow making decisions in real time, taking into account the entire technological process.	5												V

5 Curriculum of the educational program

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

SATBAYEV UNIVERSITY

APPROVED
Chairman of the Management Board-
Rector of Kaztu named after K.Satpayev
M.M. Begentaev
«__» _____ 2023 y.

CURRICULUM
of Educational Program on enrollment for 2023-2024 academic year

Educational program 6B07213 - "Mineral processing"
Group of educational programs B071 - "Mining and extraction of minerals"

Form of study: full-time Duration of study: 4 years Academic degree: Bachelor of Engineering and Technology

Discipline code	Name of disciplines	Cycle	Total amount in credits	Total hours	classroom volume of lek/lab/pr	SIS (including TSIS) in hours	Form of control	Allocation of face-to-face training based on courses and semesters							
								I course		II course		III course		IV course	
								1 semester	2 semester	3 semester	4 semester	5 semester	6 semester	7 semester	8 semester
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)															
M-1. Module of language training															
LNG108	English language	GED, RC	10	300	0/0/6	210	E	5	5						
LNG104	Kazakh (Russian) language	GED, RC	10	300	0/0/6	210	E	5	5						
M-2. Module of physical training															
KFK101-104	Physical Culture	GED, RC	8	240	0/0/8	120	Difcredit	2	2	2	2				
M-3. Module of information technology															
CSE677	Information and communication technologies (in English)	GED, RC	5	150	2/1/0	105	E				5				
M-4. Module of socio-cultural development															
HUM137	History of Kazakhstan	GED, RC	5	150	1/0/2	105	SE		5						
HUM132	Philosophy	GED, RC	5	150	1/0/2	105	E				5				
HUM120	Socio-political knowledge module (sociology, politology)	GED, RC	3	90	1/0/1	60	E				3				
HUM134	Socio-political knowledge module (culturology, psychology)		5	150	2/0/1	105	E			5					
M-5. Module of anti-corruption culture, ecology and life safety base															
HUM136	The base of anti-corruption culture and law	ED, CC	5	150	2/0/1	105	E			5					
MNG489	Fundamentals of economics and entrepreneurship														
HPP128	Fundamentals of research methods														
CHE656	Ecology and life safety														
CYCLE OF BASIC DISCIPLINES (BD)															
M-6. Module of physical and mathematical training															
MAT101	Mathematics I	BD, UC	5	150	1/0/2	105	E	5							
PHY468	Physics	BD, UC	5	150	1/1/1	105	E	5							
MAT102	Mathematics II	BD, UC	5	150	1/0/2	105	E		5						

MIN508	Fundamentals of mining technology	PD, UC	5	150	1/0/2	105	E				5				
MET507	Flotation methods of enrichment	PD, UC	4	120	2/1/0	75	E						4		
M-10. Professional activity module																
MET531	Enrichment of polymetallic ores	PD, CCH	5	150	1/1/1	105	E						5		
MET648	Technologies for processing uranium-containing ores and concentrates				2/1/0										
MET419	Enrichment of rare metal ores	PD, CCH	4	120	2/1/0	75	E						4		
MET157	Enrichment of ores of ferrous metals				1/1/1										
MET156	Modeling of concentrating processes	PD, CCH	6	180	2/1/1	120	E							6	
MET151	Geotechnological methods of enriching				2/1/1										
MET536	Enrichment of mining and chemical and non-metallic raw materials	PD, CCH	5	150	2/1/0	105	E							5	
MET569	Technology of underground leaching of ores				2/1/0										
MET570	Magnetic and electrical methods of lightening	PD, CCH	5	150	2/1/0	105	E								5
MET537	Enrichment of ferrous metal ores				1/1/1										
MET571	Special and combined methods of dressing	PD, CCH	5	150	1/1/1	105	E								5
MET572	Fundamentals of scientific research in ore dressing				2/1/0										
MET574	Ore beneficiation research	PD, CCH	4	120	2/1/0	75	E								4
MET453	Industrial water supply, transport and tailings of concentrating factories				2/0/1										
AAP143	Production practice I	PD, UC	2		0/0/2						2				
AAP183	Production practice II	PD, UC	3		0/0/3								3		
M-11. Module of "R&D"																
MET564	Design of concentrating factory	PD, CCH	5	150	2/1/0	105	E								5
MET649	Digitalization of mining and processing plants				2/0/1										
M-12. Module of final attestation																
ECA108	Final examination	FA	8												8
M-13. Module of additional types of training																
AAP500	Military affairs	ATT	0												
Total based on UNIVERSITY:								31	29	28	32	29	31	33	27
								60		**60**		**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	51		5	56
BD	Cycle of basic disciplines		76	31	176
PD	Cycle of profile disciplines		30	39	
	Total for theoretical training:	*51*	*106*	*75*	*232*
FA	Final attestation	8			8
	TOTAL:	**59**	**106**	**75**	**240**

Decision of the Academic Council of KazNRTU named after K.Satpayev. Protocol №5, 24.11.2022 y.

Decision of the Educational and Methodological Council of KazNRTU named after K.Satpayev. Protocol №3, 17.11.2022 y.

Decision of the Academic Council of MaMI named after O. Baikonurov. Protocol №3, 15.11.2022 y.

Vice-Rector for Academic Affairs — **B.A. Zhautikov**

Director of the Mining and Metallurgical Institute named after O. A. Baikonurov — **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**

Representative of the employers' council of the JSC "Goldstone Minerals" — **A.K. Arinov**

Representative of the employers' council of the Weizmann RI — **V.A. Kaplan**

6. Additional educational programs (Minor)

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