Mining and Metallurgical Institute named after O.A. Baikonurov
Department "Metallurgy and mineral processing"
Department of Metallurgical Processes, Heat Engineering and Technology of Special Materials

EDUCATIONAL PROGRAM

7M07204 – Metallurgy and mineral processing

Code and classification of the field of education:	7M07 – Engineering, manufacturing and construction industries
Code and classification of areas of study:	7M072 – Manufacturing and manufacturing industries
Group of educational programs:	M117 – Metallurgical engineering
NQF level:	Level 7 - Postgraduate education. Master (based on the mastered bachelor's 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
Training period:	4 years
Volume of loans:	120

Almaty, 2022

The educational program "7M07204 - Metallurgy and mineral processing" was approved at a meeting of the Academic Council of KazNTU named after. K.I. Satpaeva.

Protocol No. 13 dated "28" 04 2022

Considered and recommended for approval at a meeting of the Educational and Methodological Council of KazNITU named after. K.I. Satpaeva.

Protocol No. 7 dated "26" 04 2022

The educational program "7M07204 - Metallurgy and mineral processing" was developed by the academic committee in the direction "Production and manufacturing industries"

FULL NAME	Academic degree/ academic title	Job title	Place of work	Signature
Chairman of the academic committee:				
Barmenshinova M.B.	c.t.s.	Head of the Department of MaMP	KazNITU named after K.I. Satpaeva	
Chepushtanova T.A.	PhD doctor	Head of the Department of MPHEaTSM	KazNITU named after K.I. Satpaeva	
Teaching staff:				
Baimbetov B.S.	c.t.s., docent	Professor of the Departament of MaMP	KazNITU named after K.I. Satpaeva	
Usoltseva G.A.	c.t.s.	Associate Professor of the Departament of MPHEaTSM	KazNITU named after K.I. Satpaeva	
Employers:				
Ospanov E.A.	Doctor of Technical Sciences	Head of department of complex processing of technogenic raw materials	Kazakhmys Corporation LLP	
Mishra B.	PhD doctor	Director of the Institute of metalworking	Worcester Polytechnic Institute (USA)	
Students				
Turymbai N.D.	-	4th year student	KazNITU named after K.I. Satpaeva	

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List of abbreviations and symbols

NAO "Kazakh National Research Technical University named after K.I. Satpayev" - NAO KazNITU named after K.I. Satpayev;

SOSE - State obligatory standard of education of the Republic of Kazakhstan;

MES RK - Ministry of Education and Science of the Republic of Kazakhstan;

EP - educational 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;

SQF - Sectoral Qualifications Framework;

LO - learning outcomes;

KC - key competencies.

1. Description of the educational program

Introduction to the educational program. The development of an innovative economy initially forms the so-called double helixes of interaction - between universities (science) and business, business and government, etc., which then form a "triple helix". The triple helix model generates interdisciplinary knowledge generated by interdisciplinary teams brought together for a short time to work on a specific real-world problem. In the triple helix model, universities, along with the educational and research function, further increase entrepreneurial functions, actively participating in the cultivation of start-ups 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 the deep training of specialists in a narrowly focused specialization, has led to the emergence of interdisciplinary barriers and curbing the development of new "growth points" that are at the intersection of disciplines.

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

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

The program is complex and science 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 metallurgical industry, adapted to work in high-tech sectors of the economy of the Republic of Kazakhstan based on the development of priority areas of science and

technology, the development of high-tech industries, competitive technologies in the field of processing man-made raw materials and waste.

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

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

Planning the content of education, the method 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 education.

The master's program in the 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 educational program of the master's program consists of:

1) theoretical education, including the study of cycles of basic and major 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 magistracy

4) final certification.

The educational program includes the following stages of undergraduate training: English (professional), psychology of management, history and philosophy of science, pedagogy of higher education, engineering calculations in metallurgy, theory and calculations of metallurgical thermodynamics and kinetics, technologies and processes of rectification and condensation in metallurgy, technology and refining of radioactive metals, modern and promising technologies for processing ore and technogenic raw materials, technology and refining of noble metals, theory of processes of metallurgical engineering, modern and promising technologies for processing raw materials of ferrous and non-ferrous metallurgy, special methods of hydrometallurgy, technology for the isolation and utilization of toxic elements from metallurgical raw materials , technologies for processing uranium-containing raw materials, technologies for extracting metals from slags, chlorine and vacuum technologies in metallurgy, project management, recycling technologies in ferrous and non-ferrous metallurgy, mass transfer os in heterophase metallurgical systems, processes and production of ultra-pure metals, special chapters in extractive metallurgy (in English), technology of fractional separation

of metals from a vapor-gas mixture, plasma metallurgy.

Possibility 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 master's program "Metallurgy and mineral processing" can perform the following types of professional activities: design, production and technology, organizational and managerial, research and teaching.

A distinctive feature of the master's program is that the educational program provides knowledge, skills and abilities in the use of "green" technologies and materials, the production and sale of metallurgical products; on the development of regulatory and technical documentation for the metallurgical sector; for the improvement and preparation of means of metallurgical production. Graduates receive knowledge in the field of development and implementation of metallurgical technologies, production of innovative metallurgical products, enhanced consumer properties; graduates have high leadership and organizational qualities; capable of creating small science-intensive metallurgical businesses.

The mission of the educational program of the master's program "Metallurgy and mineral processing" is the formation of students' social and personal qualities and professional competencies that allow graduates to successfully solve production, technological, organizational and managerial, design tasks in the field of metallurgy, 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 metallurgy, specializing in the implementation of promising fundamental, innovative, digital and applied research and the development and implementation of modern technological processes that provide high quality products at minimal cost.

Objects of professional activity. The objects of professional activity of graduates are enterprises of ferrous and non-ferrous metallurgy, chemical, mining and chemical and machine-building industries, industry research and design institutes, factory laboratories, higher and secondary vocational schools, government authorities and organizations of various organizational and legal forms.

Types and objects of professional activity.

The subjects of professional activity are the technological processes of the metallurgical industry, the production of metal products with increased consumer properties, the technology for obtaining and processing metals and materials, the study of the structure and properties, automatic control systems for metallurgical production and quality control of the final product.

2. Purpose and objectives of the educational program

The purpose of EP "7M07204 - Metallurgy and mineral processing" is:

– formation of personnel for an innovative economy in metallurgy and mineral processing, covering modern energy-saving technologies, project activities, innovative solutions, entrepreneurship in the high-tech sphere of mineral processing.

The tasks of the EP "7M07204 - Metallurgy and mineral processing" are:

- Competence of graduates in design and technological work in the implementation of projects to improve and optimize enrichment and metallurgical 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 the processing of mineral, natural and technogenic raw materials;

- the competence of graduates in the implementation of the assessment of innovation and technological risks in the implementation of new technologies;

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

– competence in the implementation of marketing of high technologies.

3. Requirements for applicants

The previous level of education of applicants is higher professional education (bachelor's degree). The applicant must have a diploma of the established form and confirm the level of knowledge of the English language with a certificate or diplomas of the established form.

The procedure for admission of citizens to the magistracy is established in accordance with the "Model Rules for Admission to Education in Educational Organizations Implementing Educational Programs of Postgraduate Education".

The formation of a contingent of undergraduates is carried out by placing a state educational order for the training of scientific and pedagogical personnel, as well as paying for education at the expense of citizens' own funds and other sources. The state provides citizens of the Republic of Kazakhstan with the right to receive free postgraduate education on a competitive basis in accordance with the state educational order, if they receive education at this level for the first time.

At the "entrance" a master's student must have all the prerequisites necessary for mastering the corresponding educational program of the master's program. The list of required prerequisites is determined by the higher education institution independently.

In the absence of the necessary prerequisites, the undergraduate is allowed to master them on a paid basis.

4. Requirements for completing studies and obtaining a diploma

Awarded degree/qualifications: A graduate of this educational program is awarded the academic degree "Master of Engineering" in the direction of "Metallurgy and mineral processing".

A graduate who has mastered the master's program should have the following general professional competencies:

- the ability to independently acquire, comprehend, structure and use new knowledge and skills in professional activities, develop their innovative abilities;
- the ability to independently formulate research goals, establish a sequence for solving professional problems;
- the ability to put into practice the knowledge of fundamental and applied sections of the disciplines that determine the direction (profile) of the master's program;
- the ability to professionally choose and creatively use modern scientific and technical equipment to solve scientific and practical problems;
- the ability to critically analyze, present, defend, discuss and disseminate the results of their professional activities;
- possession of skills in the preparation and execution of scientific and technical documentation, scientific reports, reviews, reports and articles;
- willingness to lead a team in the field of their professional activity, tolerantly perceiving social, ethnic, confessional and cultural differences;
- readiness for communication in oral and written forms in a foreign language to solve the problems of professional activity.

A graduate who has mastered the master's program must have professional competencies corresponding to the types of professional activities that the master's program is focused on:

research activities:

- the ability to form diagnostic solutions to professional problems by integrating the fundamental sections of science and specialized knowledge obtained during the development of the master's program;
- the ability to independently conduct scientific experiments and research in the professional field, summarize and analyze experimental information, draw conclusions, formulate conclusions and recommendations;
- the ability to create and explore models of the objects under study based on the use of in-depth theoretical and practical knowledge in the field of metallurgy and mineral processing;

research and production activities:

- the ability to independently carry out production and research and production, laboratory and interpretation work in solving practical problems;
- the ability to professionally operate modern laboratory equipment and instruments in the field of the mastered master's program;
- the ability to use modern methods of processing and interpreting complex information to solve production problems;

project activity:

- the ability to independently draw up and submit projects for research and development work;

- readiness to design complex research and scientific and production works in solving professional problems;

organizational and managerial activities:

- readiness to use practical skills of organizing and managing research and scientific and production work in solving professional problems;

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

scientific and pedagogical activity:

- the ability to conduct seminars, laboratory and practical classes;

- the ability to participate in the management of the scientific and educational work of students in the field of metallurgy and enrichment.

When developing a master's program, all general cultural and general professional competencies, as well as professional competencies related to those types of professional activities that the master's program is focused on, are included in the set of required results for mastering the master's program.

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

5.1 Requirements for key competencies of graduates of the scientific and pedagogical master's program

A graduate of a scientific and pedagogical master's program must:

have an idea:

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

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 efficiency and quality of education;
- international and domestic standards, resolutions, orders, orders of higher and other domestic organizations, methodological normative and guidance materials relating to the work performed;
- the current state and prospects for the technical and technological development of enrichment and metallurgical processes, the features of the activities of an institution, organization, enterprise and related industries;
- goals and objectives facing a specialist in the field of mineral processing and metallurgy for the development and implementation of the latest high-tech production technologies;
- methods for studying enrichment and metallurgical 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 for conducting an 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 and metallurgy;
- at least one foreign language at a professional level, allowing for scientific research and practical activities;
- methodology for conducting all types of training sessions and independent work of students.

be able to:

- develop technological processes for obtaining conditioned concentrates from ore, as well as metals from concentrates, processing metals and alloys, schemes for concentrating and metallurgical processes, substantiating regime parameters and indicators;
- draw up a business plan for a technological project;
- develop energy and resource-saving technologies in the field of mineral processing, metallurgy and metalworking;
- develop measures to protect the environment for the enrichment and metallurgical production;
- carry out planning of experimental studies, choose research methods;
- develop a scheme and design of an experimental facility, carry out installation and debugging;
- process data using planning techniques, regression and correlation analysis, digitalization methods;
- to carry out activities for the organization of production in accordance with regulatory documents;
- 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 within different disciplines to solve research problems in new unfamiliar conditions;
- by integrating knowledge, make judgments and make decisions based on incomplete or limited information;
- apply the knowledge of pedagogy and psychology of higher education in their pedagogical activities;
- apply interactive teaching methods;
- carry out information-analytical and information-bibliographic work with the involvement of modern information technologies;
- think creatively and creatively approach the solution of new problems and situations;
- be fluent in a foreign language at a professional level, allowing to conduct scientific research and teach special disciplines in universities;
- summarize the results of research and analytical work in the form of a dissertation, scientific article, report, analytical note, etc.;

have skills:

- research activities, solving standard scientific problems;

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

be competent:

- in the field of scientific 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;
B2 - The ability to independently apply methods and means of cognition, learning and self-control to acquire new knowledge and skills, including in new areas that are not directly related to the field of activity.
B3 - Be proficient in state, Russian and one of the most common 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 - Possession of 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 correct, reasoned and clearly build oral and written speech.
B6 - General engineering skills.
B7 - Possession of fundamental knowledge of the theory of mineral processing and metallurgical processes;
B8 - Basic knowledge of waste management, metal recycling.
B9 - Possession of modern and advanced technologies of metallurgical production.
B10 - Know and master the basic business processes in an industrial enterprise.
B11 - Ability to conduct pedagogical work using modern methods 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 and metallurgical processes.
P3 - ready to install, adjust and operate production systems for mineral processing and metallurgical processes;

P4 - ready to participate in the development and design of new technologies and production lines for mineral processing, obtaining finished metal-containing products.
P5 - Have the skills to draw up a hardware-technological scheme
P6 - Have the skills to carry out technological, heat engineering and energy calculations
P7 - Be able to calculate aero- and hydrodynamics according to the scheme of the chain of devices
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 and metallurgical processes, justify regime parameters and indicators
P12 - Be able to write a business plan for a technology project
P13 - Be able to develop energy and resource-saving technologies in the field of metallurgy and metalworking
P14 - Be able to develop environmental protection measures for metallurgical production
P15 - Be able to conduct a literature search, draw up reports, reviews, conclusions, etc., choose research methods, plan and conduct the necessary experiments, analyze and summarize research results, apply for patents
P16 - Mastering the methodology for processing slags and intermediate 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 abilities acquired in the course of training to develop a methodology for conducting research work related to the professional field and organize experiments with an analysis of their results
P18 - Identify issues related to the modernization and introduction of new technologies and equipment for the intensification of enrichment and metallurgical processes in order to increase the extraction of valuable components contained in it
P19 - Possess practical skills in the field of independent organization and management of research work on the topic
P20 - The ability to apply the knowledge, abilities, skills mastered in the process of studying in the educational program of the master's program.

O - Universal, social and ethical competencies

O1 - 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. Ready to use English in professional activities in the field of enrichment and metallurgy;
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. Ready to use the Kazakh (Russian) language in professional activities in the field of enrichment and metallurgy;

O3 - to know and apply in work and life the basics of applied ethics and ethics of business communication;
O4 - know and apply the basic concepts of professional ethics;
O5 - to know and solve the problems of human impact on the environment.

C - Special and managerial competencies

C1 - 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, argumentation of conclusions and competent handling of information;
C2 - be a specialist in conducting experimental studies of objects of enrichment of ore raw materials and metallurgy;
C3 - to be a researcher, a specialist in scientific research of ore raw material enrichment objects and objects of finished metal-containing products;
C4 - be an engineer for the development and design of concentrating and metallurgical shops, factories, production lines.

5.2 Requirements for the research work of a master student

Requirements for the research work of a master student in the scientific and pedagogical master's program:

1) corresponds to the profile of the educational program of the master's program, according to which the master's thesis is being carried out and defended;

2) relevant and contains scientific novelty and practical significance;

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

4) is performed using modern methods of scientific research;

5) contains research (methodological, practical) sections on the main protected provisions;

6) is based on advanced international experience in the relevant field of knowledge.

5.3 Requirements for the organization of practices

The educational program of the scientific and pedagogical magistracy includes two types of practices that are carried out in parallel with theoretical training or in a separate period:

1) pedagogical in the database cycle - at the university;

2) research in the cycle of PD - at the place of the dissertation.

Pedagogical practice is carried out in order to form practical skills in teaching and learning methods. At the same time, undergraduates are involved in conducting undergraduate studies at the discretion of the university.

The research practice of the undergraduate is carried out in order to familiarize with the latest theoretical, methodological and technological achievements of domestic and foreign science, modern methods of scientific research, processing and interpretation of experimental data.

6. Passport of the educational program

6.1. Field name

№	Field name	Note
1	Code and classification of the field of education	7M07 - Engineering, manufacturing and construction industries
2	Code and classification of areas of study	7M072 - Manufacturing and processing industries
3	Group of educational programs	M117 – Metallurgical engineering
4	Name of the educational program	Metallurgy and mineral processing
5	Brief description of the educational program	The educational program "Metallurgy and mineral processing" includes fundamental, natural science, general engineering and professional training of masters in the field of metallurgy in accordance with the development of science and technology, as well as the changing needs of the mining and metallurgical industry.
6	Purpose of the EP	formation of personnel for the innovative economy in metallurgy, covering modern energy-saving technologies, project activities, innovativeness of solutions, entrepreneurship in the high-tech sphere of processing of mineral raw materials
7	EP type	New
8	NQF level	Level 7 - Postgraduate education. Master (based on the mastered bachelor's program), practical experience.
9	ORC level	Level 7 - Conceptual professional and / or scientific knowledge (including innovative) and experience in a particular area and / or at the intersection of areas. Evaluation and selection of professional information. Creation of new applied knowledge in a certain area. Identification of sources and search for information necessary for the development of activities
10	Distinctive features of the EP	No
11	List of competencies of the educational program:	See 4.2 Matrix for correlating the learning outcomes of the educational program as a whole with the formed competencies
12	Learning outcomes of the educational program:	
13	Form of study	full-time
14	Training period	2 years
15	Volume of loans	120
16	Languages of instruction	Kazakh/Russian
17	Awarded Academic Degree	master of technical sciences
18	Developer(s) and authors:	Barmenshinova M.B. Chepushtanova T.A.

6.2. Матрица соотнесения результатов обучения по образовательной программе в целом с формируемыми компетенциями

Key competencies / Learning Outcomes	LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9
KC1 Professional competencies			V			V	V	V	V
KC2 Research competencies						V	V	V	V
KC3 Basic competencies and knowledge	V	V	V						
KC4 Communication competencies				V	V				V
KC5 Human competencies				V	V				
KC6 Managerial competencies					V				V
KC7 Cognitive competencies	V	V				V			
KC8 Creative competencies		V	V				V	V	V
KC9 Information and communication competencies	V	V	V				V		

6.3. The relationship between the attainability of the formed learning outcomes in the educational program and academic disciplines

№	Name of the discipline	Brief description of the discipline	Amount of credits	Formed learning outcomes (codes)								
				LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9
	Cycle of basic disciplines University component											
1	English (professional)	The course is designed for undergraduates of technical specialties to improve and develop foreign language communication skills in professional and academic fields. The course introduces students to the general principles of professional and academic intercultural oral and written communication using modern pedagogical technologies (round table, debates, discussions, analysis of professionally oriented cases, design). The course ends with a final exam. Undergraduates also need to study independently (MIS).	5	V	V	V						
2	Psychology of management	The course is aimed at teaching undergraduates the basics of management psychology. It will consider the specifics of management psychology, psychological patterns of management activities, personality and its potential in the management system; motivation and performance in the organization, leadership and leadership in modern management of organizations, a social group as an object of management, the psychological basis for making managerial decisions, business communication and managerial conflicts, the psychology of responsibility, creating an image as an integral part of the culture of communication, the psychology of advertising.	3	V	V	V						
3	History and philosophy of science	The subject of philosophy of science, the dynamics of science, the specifics of science, science and prescience, antiquity and the formation of theoretical science, the main stages of the historical development of science, the features of classical science, non-classical and post-non-classical science, the philosophy of mathematics, physics, engineering and technology, the specificity of engineering sciences, the ethics of science , social and moral responsibility of a scientist and engineer.	3	V	V	V						
4	Pedagogy of higher education	The course is intended for undergraduates of the scientific and pedagogical magistracy of all specialties. As part of the	3	V	V	V						

		course, undergraduates will master the methodological and theoretical foundations of higher education pedagogy, learn how to use modern pedagogical technologies, plan and organize training and education processes, master the communication technologies of subject-subject interaction between a teacher and a master student in the educational process of the university. Also undergraduates will study human resource management in educational organizations (on the example of higher education).										
		Cycle of basic disciplines Selectable Component										
5	Engineering calculations in metallurgy	The discipline studies the methods of thermodynamic, mass transfer and technological calculations in the production of non-ferrous metals, including: issues of choosing a technological scheme and basic metallurgical units; compilation of material and heat balances; building balance charts; building dependency graphs and diagrams. Examples of drawing up algorithms for engineering calculations in metallurgy, drawing up flowcharts and programs using Excel and object-oriented programming languages are considered. Algorithms and programs for planning experiments and processing experimental data are being studied.	5				V	V	V			
6	Theory and calculations of metallurgical thermodynamics and kinetics	The processes occurring in metallurgical systems are considered from the positions of thermodynamics and kinetics. The characteristics of equilibrium and non-equilibrium processes and states of metallurgical systems are given. Theoretical provisions and conclusions about the structure and properties of metallic, oxide and sulfide systems. Basic calculations on thermodynamics and kinetics of metallurgical processes. Calculation of thermodynamic and kinetic parameters using modern digital programs (software) for calculations.	5				V	V	V			
7	Technologies and processes of rectification and condensation in metallurgy	Basic laws of evaporation and sublimation. Theory of condensation processes, features of vapor-gas mixture condensation. The process of rectification, the scheme of the distillation column. Calculation of the distillation column. The role of external pressure in the processes of evaporation and condensation. Technology of rectification and condensation of zinc, titanium tetrachloride. Technology of	5				V	V		V		

		distillation and rectification of selenium and tellurium. Improving the design of dust collecting and condensing apparatuses for rectification and condensation processes in non-ferrous metallurgy.											
8	Technology and refining of radioactive metals	The course provides theoretical patterns and practice of the main processes of refining radioactive metals (uranium, thorium and plutonium), technology and instrumentation: precipitation and extraction purification methods in uranium technology.	5				V	V		V		
9	Modern and promising technologies for processing ore and technogenic raw materials	This discipline studies environmentally friendly processes of complex processing and opening of refractory ores and technogenic deposits based on a combination of modern enrichment methods, pyro- and hydrometallurgy using additional energy effects.	5					V		V	V	
10	Technology and refining of precious metals	The course studies the refining of precious metals: gold, silver (chlorine process, electrolysis refining, acid refining methods) and platinum group metals.	5				V	V		V		
		Cycle of major disciplines University component											
11	Process Theory of Metallurgical Engineering	Systematized materials on oxide melts, the structure and properties of slags, as well as on the theoretical foundations of hydrometallurgical and electrometallurgical processes, in-depth knowledge of methods for analyzing state diagrams of slag systems, "Potential - pH" diagrams, regularities of electrometallurgical processes, as well as the basic laws of thermodynamics, mechanism and kinetics of the main metallurgical processes; examples of various pyro- and hydro-electrometallurgical processing processes; methods and examples of application of software materials for thermodynamic and kinetic analysis of processes.	5				V	V	V			V
12	Modern and promising technologies for processing raw materials of ferrous and non-ferrous metallurgy	Complex processing of raw materials of ferrous and non-ferrous metallurgy. Technologies focused on solving problematic issues and obtaining products using waste-free technology. Rational processing of raw materials. Solving the problems of ecology, material and energy saving. Technologies for processing substandard and technogenic raw materials and production wastes in the country and abroad.	5					V		V	V	
13	Special methods of hydrometallurgy	Thermodynamic probability of occurrence of reactions of leaching of mineral raw materials by alkaline reagents.	5				V	V	V			V

		Kinetics of the leaching process. State of metals in solutions of hydroxyl reagents. Technological features of the production of alumina by the hydro-alkaline method. Organization of associated extraction of vanadium and gallium in the processing of alumina-containing raw materials. Ammonia hydrometallurgy. Equilibria of complex formation in aqueous ammonia solutions. Physical and chemical prerequisites for the use of mixed solutions of sodium hydroxide and ammonia as leaching reagents. Instrumentation of leaching processes. Examples of industrial use of hydro-alkaline processing of mineral and technogenic raw materials. Some technological aspects and prospects for the development of ammonia hydrometallurgy.										
14	Technology for isolation and utilization of toxic elements from metallurgical raw materials	Characteristics of secondary technogenic raw materials in metallurgy. Technology of utilization of sulfur dioxide in the industrial production of non-ferrous metals from sulfide raw materials. Utilization and neutralization of gases containing fluorine, chlorine and other harmful substances. Technology for the isolation and utilization of antimony and arsenic from waste gases from the processing of sulfide antimony-arsenic-containing concentrates. Technology for extracting fluorine from aluminum production waste. Purification and utilization of industrial effluents from non-ferrous metallurgy. Selection of reagents for reclamation of contaminated lands.	5					V		V	V	
15	Technologies for processing uranium-containing raw materials	General technological scheme of hydrometallurgical processing of uranium ores. Interaction of leaching reagents with uranium ores, qualitative and quantitative composition of uranium solutions. Theory of ion exchange. Processing of uranium solutions using cation exchangers and anion exchangers. Methods for desorption of uranium from ion exchangers. Equipment for ion exchange processes. Processing of uranium solutions using alkylamines. Processing of uranium solutions using neutral extractants.	5				V		V	V		
		Cycle of major disciplines Selectable Component										
16	Technologies for extracting metals from slags	Physical and chemical properties of slags. Selection of slag-forming fluxes for optimal conduct of metallurgical processing of polymetallic raw materials. The content of valuable metals in non-ferrous and ferrous metallurgy slags.	5				V			V	V	

		Existing methods of slag depletion. Selection of technological modes, reagents and equipment for the processing of non-ferrous metallurgy slags in order to maximize the complete extraction of valuable non-ferrous metals with the production of waste slag suitable for use in the construction industry. Ways to reduce the content of non-ferrous metals in the resulting metallurgical slags.										
17	Chlorine and vacuum technologies in metallurgy	Modern methods of processing various raw materials using chlorine and vacuum technology. Characteristics of chlorides and thermodynamics of chlorination, forms of finding non-ferrous and valuable metals. Choice and substantiation of chlorine and vacuum technology in the processing of materials containing non-ferrous and valuable metals, economic analysis and evaluation.	5				V		V		V	
18	Project management	After the successful completion of the discipline, undergraduates will gain knowledge about the key components of project management, with an emphasis on modern behavioral models of project-oriented business development management. The course program is built on international standards recognized by the business community PMI PMBOK, IPMA ICB and national standards of the Republic of Kazakhstan in the field of project management. The features of organizational management of business development through projects are studied in the interrelation of strategic, project and operational management. The system of practices, methods and procedures used in the innovative activity of organizations is considered, taking into account the psychological aspects of team building, communications and interaction with stakeholders.	5	V	V	V						
19	Recycling technologies in ferrous and non-ferrous metallurgy	Metallurgical waste. Rational use and processing of waste and slag. Theory and practice of modern metallurgy waste recycling processes. Getting rid of metallurgical enterprises from accumulated and generated industrial waste. Recycling technology: primary sorting, cleaning, rejection; distribution to production lines; storage of the final product; removal and disposal at the landfill.	5				V			V	V	
20	Mass transfer in heterophase metallurgical systems	Basic concepts and general characteristics of mass transfer, its types and stages. phase rule. Line of balance. Systems: gas-liquid, vapor-liquid, liquid-liquid, liquid-solid, solid-	5					V		V	V	

		solid. Calculation of mass transfer and mass transfer coefficients.										
21	Processes and production of high-purity metals	Equipment and technology for the production of highly pure metals in non-ferrous metallurgy. Refining and purification of base metals from impurities in non-ferrous metallurgy. Influence of pressure in equipment, neutral gas and temperature for fractional separation of volatile components of non-ferrous metals and their compounds. Processes of zone crystallization and condensation for obtaining high-purity metals. Vacuum and plasma production of highly pure metals.	5				V	V			V	
22	Special chapters in extractive metallurgy (in English)	The course examines the role of extractive metallurgy in the mining and metallurgical sector. Thermodynamics of metallurgical processes. Phase diagrams, phase transformations and prediction of metal properties. Measurement and evaluation of the physical properties of metals at high temperatures. Transport phenomena and properties of metals. Kinetics of metallurgical reactions. Thermoanalytical methods of metal processing. Critical, strategic raw material of extractive metallurgy. Complex processing of mineral, resistant raw materials. Pyrometallurgical processing of critical raw materials. Innovative technologies for pyrometallurgical processing of metals.	5				V	V	V			
23	Technology of fractional separation of metals from vapor-gas mixture	The main reactions occurring during the pyrometallurgical processing of mineral raw materials. Characteristics of sublimation processes. Equipment for sublimation and condensation of vapors of non-ferrous metals and their compounds. Fractional separation and condensation of vapors of volatile components.	5				V	V		V		
24	Plasma metallurgy	Conduct research on the influence of operating parameters on the technological characteristics of plasma processes; to compare various vacuum-plasma methods, to have practical skills in working on technological plasma equipment, to use instrumentation to determine the operating parameters of vacuum-plasma processes.	5				V	V		V		

6.4. Information about modules/disciplines

№	Name of the discipline	Brief description of the discipline (30-50 words)	Amount of credits	Formed competencies (codes)
Cycle of basic disciplines University component				
1	English (professional)	The course is designed for undergraduates of technical specialties to improve and develop foreign language communication skills in professional and academic fields. The course introduces students to the general principles of professional and academic intercultural oral and written communication using modern pedagogical technologies (round table, debates, discussions, analysis of professionally oriented cases, design). The course ends with a final exam. Undergraduates also need to study independently (MIS).	5	KK1, KK3, KK7, KK8, KK9
2	Psychology of management	The course is aimed at teaching undergraduates the basics of management psychology. It will consider the specifics of management psychology, psychological patterns of management activities, personality and its potential in the management system; motivation and performance in the organization, leadership and leadership in modern management of organizations, a social group as an object of management, the psychological basis for making managerial decisions, business communication and managerial conflicts, the psychology of responsibility, creating an image as an integral part of the culture of communication, the psychology of advertising.	3	KK1, KK3, KK7, KK8, KK9
3	History and philosophy of science	The subject of philosophy of science, the dynamics of science, the specifics of science, science and prescience, antiquity and the formation of theoretical science, the main stages of the historical development of science, the features of classical science, non-classical and post-non-classical science, the philosophy of mathematics, physics, engineering and technology, the specificity of engineering sciences, the ethics of science , social and moral responsibility of a scientist and engineer.	3	KK1, KK3, KK7, KK8, KK9
4	Pedagogy of higher education	The course is intended for undergraduates of the scientific and pedagogical magistracy of all specialties. As part of the course, undergraduates will master the methodological and theoretical foundations of higher education pedagogy, learn how to use modern pedagogical technologies, plan and organize training and education processes, master the communication technologies of	3	KK1, KK3, KK7, KK8, KK9

		subject-subject interaction between a teacher and a master student in the educational process of the university. Also undergraduates will study human resource management in educational organizations (on the example of higher education).		
Basic disciplines Selectable Component				
5	Engineering calculations in metallurgy	The discipline studies the methods of thermodynamic, mass transfer and technological calculations in the production of non-ferrous metals, including: issues of choosing a technological scheme and basic metallurgical units; compilation of material and heat balances; building balance charts; building dependency graphs and diagrams. Examples of drawing up algorithms for engineering calculations in metallurgy, drawing up flowcharts and programs using Excel and object-oriented programming languages are considered. Algorithms and programs for planning experiments and processing experimental data are being studied.	5	KK1, KK2, KK4, KK5, KK6, KK7
6	Theory and calculations of metallurgical thermodynamics and kinetics	The processes occurring in metallurgical systems are considered from the positions of thermodynamics and kinetics. The characteristics of equilibrium and non-equilibrium processes and states of metallurgical systems are given. Theoretical provisions and conclusions about the structure and properties of metallic, oxide and sulfide systems. Basic calculations on thermodynamics and kinetics of metallurgical processes. Calculation of thermodynamic and kinetic parameters using modern digital programs (software) for calculations.	5	KK1, KK2, KK4, KK5, KK6, KK7
7	Technologies and processes of rectification and condensation in metallurgy	Basic laws of evaporation and sublimation. Theory of condensation processes, features of vapor-gas mixture condensation. The process of rectification, the scheme of the distillation column. Calculation of the distillation column. The role of external pressure in the processes of evaporation and condensation. Technology of rectification and condensation of zinc, titanium tetrachloride. Technology of distillation and rectification of selenium and tellurium. Improving the design of dust collecting and condensing apparatuses for rectification and condensation processes in non-ferrous metallurgy.	5	KK1, KK2, KK4, KK5, KK6, KK8, KK9
8	Technology and refining of radioactive metals	The course provides theoretical patterns and practice of the main processes of refining radioactive metals (uranium, thorium and plutonium), technology and instrumentation: precipitation and extraction purification methods in uranium technology.	5	KK1, KK2, KK4, KK5, KK6, KK8, KK9

9	Modern and promising technologies for processing ore and technogenic raw materials	This discipline studies environmentally friendly processes of complex processing and opening of refractory ores and technogenic deposits based on a combination of modern enrichment methods, pyro- and hydrometallurgy using additional energy effects.	5	KK1, KK2, KK4, KK5, KK6, KK8
10	Technology and refining of precious metals	The course studies the refining of precious metals: gold, silver (chlorine process, electrolysis refining, acid refining methods) and platinum group metals.	5	KK1, KK2, KK4, KK5, KK6, KK8, KK9
Cycle of major disciplines University component				
11	Process Theory of Metallurgical Engineering	Systematized materials on oxide melts, the structure and properties of slags, as well as on the theoretical foundations of hydrometallurgical and electrometallurgical processes, in-depth knowledge of methods for analyzing state diagrams of slag systems, "Potential - pH" diagrams, regularities of electrometallurgical processes, as well as the basic laws of thermodynamics, mechanism and kinetics of the main metallurgical processes; examples of various pyro- and hydro-electrometallurgical processing processes; methods and examples of application of software materials for thermodynamic and kinetic analysis of processes.	5	KK1, KK2, KK4, KK5, KK6, KK7, KK8
12	Modern and promising technologies for processing raw materials of ferrous and non-ferrous metallurgy	Complex processing of raw materials of ferrous and non-ferrous metallurgy. Technologies focused on solving problematic issues and obtaining products using waste-free technology. Rational processing of raw materials. Solving the problems of ecology, material and energy saving. Technologies for processing substandard and technogenic raw materials and production wastes in the country and abroad.	5	KK1, KK2, KK4, KK5, KK6, KK8
13	Special methods of hydrometallurgy	Thermodynamic probability of occurrence of reactions of leaching of mineral raw materials by alkaline reagents. Kinetics of the leaching process. State of metals in solutions of hydroxyl reagents. Technological features of the production of alumina by the hydro-alkaline method. Organization of associated extraction of vanadium and gallium in the processing of alumina-containing raw materials. Ammonia hydrometallurgy. Equilibria of complex formation in aqueous ammonia solutions. Physical and chemical prerequisites for the use of mixed solutions of sodium hydroxide and ammonia as leaching reagents. Instrumentation of leaching processes. Examples of industrial use of hydro-alkaline processing of mineral and technogenic raw materials. Some technological aspects and prospects for	5	KK1, KK2, KK4, KK5, KK6, KK7, KK8

		the development of ammonia hydrometallurgy.		
14	Technology for isolation and utilization of toxic elements from metallurgical raw materials	Characteristics of secondary technogenic raw materials in metallurgy. Technology of utilization of sulfur dioxide in the industrial production of non-ferrous metals from sulfide raw materials. Utilization and neutralization of gases containing fluorine, chlorine and other harmful substances. Technology for the isolation and utilization of antimony and arsenic from waste gases from the processing of sulfide antimony-arsenic-containing concentrates. Technology for extracting fluorine from aluminum production waste. Purification and utilization of industrial effluents from non-ferrous metallurgy. Selection of reagents for reclamation of contaminated lands.	5	KK1, KK2, KK4, KK5, KK6, KK8
15	Technologies for processing uranium-containing raw materials	General technological scheme of hydrometallurgical processing of uranium ores. Interaction of leaching reagents with uranium ores, qualitative and quantitative composition of uranium solutions. Theory of ion exchange. Processing of uranium solutions using cation exchangers and anion exchangers. Methods for desorption of uranium from ion exchangers. Equipment for ion exchange processes. Processing of uranium solutions using alkylamines. Processing of uranium solutions using neutral extractants.	5	KK1, KK2, KK4, KK5, KK7, KK8, KK9
Cycle of major disciplines Selectable Component				
16	Technologies for extracting metals from slags	Physical and chemical properties of slags. Selection of slag-forming fluxes for optimal conduct of metallurgical processing of polymetallic raw materials. The content of valuable metals in non-ferrous and ferrous metallurgy slags. Existing methods of slag depletion. Selection of technological modes, reagents and equipment for the processing of non-ferrous metallurgy slags in order to maximize the complete extraction of valuable non-ferrous metals with the production of waste slag suitable for use in the construction industry. Ways to reduce the content of non-ferrous metals in the resulting metallurgical slags.	5	KK1, KK2, KK4, KK5, KK8, KK9
17	Chlorine and vacuum technologies in metallurgy	Modern methods of processing various raw materials using chlorine and vacuum technology. Characteristics of chlorides and thermodynamics of chlorination, forms of finding non-ferrous and valuable metals. Choice and substantiation of chlorine and vacuum technology in the processing of materials containing non-ferrous and valuable metals, economic analysis and evaluation.	5	KK1, KK2, KK4, KK5, KK8
18	Project management	After the successful completion of the	5	KK1, KK3, KK7,

		discipline, undergraduates will gain knowledge about the key components of project management, with an emphasis on modern behavioral models of project-oriented business development management. The course program is built on international standards recognized by the business community PMI PMBOK, IPMA ICB and national standards of the Republic of Kazakhstan in the field of project management. The features of organizational management of business development through projects are studied in the interrelation of strategic, project and operational management. The system of practices, methods and procedures used in the innovative activity of organizations is considered, taking into account the psychological aspects of team building, communications and interaction with stakeholders.		KK8, KK9
19	Recycling technologies in ferrous and non-ferrous metallurgy	Metallurgical waste. Rational use and processing of waste and slag. Theory and practice of modern metallurgy waste recycling processes. Getting rid of metallurgical enterprises from accumulated and generated industrial waste. Recycling technology: primary sorting, cleaning, rejection; distribution to production lines; storage of the final product; removal and disposal at the landfill.	5	KK1, KK2, KK4, KK5, KK8, KK9
20	Mass transfer in heterophase metallurgical systems	Basic concepts and general characteristics of mass transfer, its types and stages. phase rule. Line of balance. Systems: gas-liquid, vapor-liquid, liquid-liquid, liquid-solid, solid-solid. Calculation of mass transfer and mass transfer coefficients.	5	KK1, KK2, KK4, KK5, KK6, KK8
21	Processes and production of high-purity metals	Equipment and technology for the production of highly pure metals in non-ferrous metallurgy. Refining and purification of base metals from impurities in non-ferrous metallurgy. Influence of pressure in equipment, neutral gas and temperature for fractional separation of volatile components of non-ferrous metals and their compounds. Processes of zone crystallization and condensation for obtaining high-purity metals. Vacuum and plasma production of highly pure metals.	5	KK1, KK2, KK4, KK5, KK6, KK8
22	Special chapters in extractive metallurgy (in English)	The course examines the role of extractive metallurgy in the mining and metallurgical sector. Thermodynamics of metallurgical processes. Phase diagrams, phase transformations and prediction of metal properties. Measurement and evaluation of the physical properties of metals at high temperatures. Transport phenomena and properties of metals. Kinetics of metallurgical reactions. Thermoanalytical methods of metal	5	KK1, KK2, KK4, KK5, KK6, KK7

		processing. Critical, strategic raw material of extractive metallurgy. Complex processing of mineral, resistant raw materials. Pyrometallurgical processing of critical raw materials. Innovative technologies for pyrometallurgical processing of metals.		
23	Technology of fractional separation of metals from vapor-gas mixture	The main reactions occurring during the pyrometallurgical processing of mineral raw materials. Characteristics of sublimation processes. Equipment for sublimation and condensation of vapors of non-ferrous metals and their compounds. Fractional separation and condensation of vapors of volatile components.	5	KK1, KK2, KK4, KK5, KK6, KK8, KK9
24	Plasma metallurgy	Conduct research on the influence of operating parameters on the technological characteristics of plasma processes; to compare various vacuum-plasma methods, to have practical skills in working on technological plasma equipment, to use instrumentation to determine the operating parameters of vacuum-plasma processes.	5	KK1, KK2, KK4, KK5, KK6, KK8, KK9

7. Curriculum of the educational program

MINISTRY OF EDUCATION AND SCIENCE OF THE REPUBLIC OF KAZAKHSTAN
KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I.SATPAYEV

SATBAYEV UNIVERSITY

APPROVED
Chairman of the Management Board-
Rector of Satbayev University named after K. Satpayev
M.Zh. Ergenbayev
«29» 04 2022 y.

CURRICULUM
of Educational Program on enrollment for 2022-2023 academic year

Educational program 7M07204 - "Metallurgy and mineral processing"
Group of educational programs M117 - "Metallurgical engineering"

Form of study: full-time | Duration of study: 2 year | Academic degree:

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)											
M-1. Module of basic training (university component)											
LNG210	English (professional)	BD UC	5	150	0/0/3	105	E	5			
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											
MET235	Engineering calculations in metallurgy	BD CCH	5	150	2/0/1	105	E	5			
MET289	Theory and calculations of metallurgical thermodynamics and kinetics				2/0/1						
MET242	Technologies and processes of distillation and condensation in metallurgy	BD CCH	5	150	2/0/1	105	E	5			
MET759	Technology and refining of radioactive metals				2/0/1						
MET263	Current and future technology for the processing of ore and technogenic raw materials	BD CCH	5	150	2/1/0	105	E			5	
MET758	Technology and refining of precious metals				2/0/1						
CYCLE OF PROFILE DISCIPLINES (PD)											
M-2. Module of professional activity (university component, component of choice)											
MET757	Theory of mineral processing processes	PD UC	5	150	2/0/1	105	E	5			
MET752	Current and future technologies for processing raw materials of ferrous and nonferrous metallurgy	PD UC	5	150	2/1/0	105	E	5			
MET760	Special methods of hydrometallurgy	PD UC	5	150	2/0/1	105	E		5		
MET751	The technology of selection and disposal of toxic elements from the metallurgical raw materials	PD UC	5	150	2/0/1	105	E			5	
MET295	Technologies of processing of uranium-containing raw materials	PD UC	5	150	2/0/1	105				5	
MET243	Technology of extracting metals from slag	PD, CCH	5	150	2/0/1	105	E		5		
MET283	Chlorine and vacuum technologies in metallurgy				2/1/0						
MNG705	Project Management				2/0/1						
MET281	Recycling technologies in ferrous and non-ferrous metallurgy	PD, CCH	5		2/1/0	105	E		5		
MET761	Mass transfer in heterophase metallurgical systems			150	2/0/1						
MET239	Processes and production of super-pure metals	PD, CCH	5		2/0/1	105	E			5	
MET762	Special chapters of extractive metallurgy (in English)			150	2/0/1						
MET250	Technology of fractional separation of metals from the gas mixture	PD, CCH	5		2/0/1	105	E			5	
MET763	Plasma metallurgy			150	2/0/1						
M-3. Practice-oriented module											
AAP229	Pedagogical practice	BD UC	6						6		
AAP256	Research practice	PD, UC	4								4
M-4. Experimental research module											
AAP251	Research work of a master's student, including internship and completion of a master's thesis	RWMS UC	2					2			
AAP241	Research work of a master's student, including internship and completion of a master's thesis	RWMS UC	3						3		
AAP254	Research work of a master's student, including internship and completion of a master's thesis	RWMS UC	5							5	
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											
ECA205	Preparation and defense of a master's thesis	FA	12								12
	Total based on UNIVERSITY:							30	30	30	30

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		29	20	49
	Total for theoretical training:	*0*	*49*	*35*	*84*
	RWMS				*24*
FA	Final attestation	12			12
	TOTAL:	12	49	35	120

Decision of the Academic Council of KazNRTU named after K.Satpayev. Protocol № 13 от "28" 04 2022 y.

Decision of the Educational and Methodological Council of KazNRTU named after K.Satpayev. Protocol № 7 от "26" 04 2022 y.

Decision of the Academic Council of MaMI named after O. Baikonurov. Protocol № 5 от "23" 12 2021 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**

Head of department "Metallurgical processes, heat engineering and technology of special materials" — **T.A. Chepushtanova**

Partner university:
Worcester Polytechnic Institute (USA) — **B. Mishra**

Representative of the employers' council of the LLP "Kazakhmys" — **E.A. Ospanov**

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)

CHANGE REGISTRATION SHEET

Sequence number of the change	Section, paragraph of the document	Type of change (replace, cancel, add)	Number and date of notification	The change has been made	
				Date	Surname and initials, signature, position