



SATBAYEV
UNIVERSITY

Mining and Metallurgical Institute named after O.A. Baikonurov

Department of Metallurgy and Mineral Processing

EDUCATIONAL PROGRAM

7M07232 – «Extractive metallurgy»

Code and classification of the field of education:	7M07 - Engineering, manufacturing and construction industries
Code and classification of training directions:	7M072 Manufacturing and processing industries
Group of educational programs:	M117 – «Metallurgical Engineering»
Level based on NQF:	7
Level based on IQF:	7
Study period:	1,5 years
Amount of credits:	90

Almaty 2025

Educational program «7M07232 - Extractive Metallurgy» was approved at the meeting of K.I. Satbayev KazNRTU Academic Council

Protocol № 4 dated «12» 12 2024 y.

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

Protocol № 3 dated «20» 12 2024 y.

Educational program «7M07232 – Extractive Metallurgy» was developed by Academic committee based on direction «7M072 – Manufacturing and processing industries»

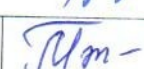
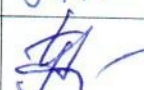
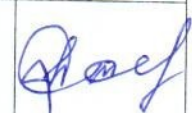
Full name	Academic degree/ academic title	Position	Workplace	Signature
Chairperson of Academic Committee:				
Barmenshinova M.B.	c.t.s., associate professor	Head of the Department of MaMP	K.I. Satbayev KazNRTU	
Teaching staff:				
Moldabayeva G.Zh.	c.t.s., associate professor	Professor of the Department of MaMP	K.I. Satbayev KazNRTU	
Ussoltseva G.A.	c.t.s.	Associate professor of the Department of MaMP	K.I. Satbayev KazNRTU	
Employers:				
Ospanov Y.A.	d.t.s.	Head of Department of complex processing of technogenic raw materials	Kazakhmys Holding LLP	
Students:				
Sagyndyk A.N.	bachelor of engineering and technology	2 nd year master's student	«KAZ Minerals» LLP	

Table of contents

List of abbreviations and designations

1. Description of educational program
2. Purpose and objectives of educational program
3. Requirements for the evaluation of educational program learning outcomes
4. Passport of educational program
 - 4.1. General information
 - 4.2. Relationship between the achievability of the formed learning outcomes according to educational program and academic disciplines
5. Curriculum of educational program

List of abbreviations and designations

NCJS "Kazakh National Research Technical University named after K.I. Satpayev" – NCJS KazNITU named after K.I. Satpayev;

TSCSE – The State compulsory 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);

IWSWT – 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.

SDGs – sustainable development goals

1. Description of educational program

The educational program 7M07232 - "Extractive metallurgy" includes sectoral, priority, fundamental, natural science, general engineering and professional training of masters in the field of extractive metallurgy, aimed at modern, complex, resource-saving, lean and sparing processing of raw materials and production of products with increased added value, to obtain energy-generating metals, in accordance with atlas of new professions, production requests and trends in the global metals market.

It is intended for the implementation of specialized bachelor's degree training under the educational program 7M07232 - "Extractive Metallurgy" at Satbayev University and was developed within the framework of the direction "Manufacturing and processing industries".

A distinctive feature of the 7M07232 - Extractive Metallurgy program is that the educational program provides international, practice-oriented training of undergraduates capable of independent research and innovation and project activities. The concept of the educational program differs in that the training is aimed at the formation of competencies for obtaining energy-generating metals; transformation of existing technologies in the field of non-ferrous metallurgy to the principles of gentle, environmentally friendly, complex processing of raw materials in conditions of depletion of ores and waste, while simultaneously digitalizing production.

Training of qualified specialists in the field of metallurgy, capable of designing, developing, managing and operating engineering systems and calculations, taking into account the criteria of sustainable development, environmental and social responsibility, as well as management principles within the framework of the ESG and the Sustainable Development Goals (SDGs).

Introduction to the educational program. The development of an innovative economy involves the training of specialists in the field of metallurgy, corresponding to the atlas of new professions and trends in the development of the metallurgical sector, namely in the following areas: adaptation of technological schemes to depletion of ores, greening of metallurgical industries, efficient recycling of waste from the metallurgical sector, increased automation and robotization of production, increasing the degree of wear of equipment in the mining and metallurgical sector.

The educational program is aimed at the formation of competencies in the field of new metallurgical technologies and promising areas of development of technologies for processing raw materials of heavy and light metals, rare and noble, refractory, energy-generating metals, as well as the study of methodological principles of lean R& D and the practice of their use to measure the level of readiness of an innovative product /project for commercialization.

The program corresponds to the unified state policy of long-term socio-economic development of the country, training of highly qualified personnel based

on the achievements of science and technology, effective use of domestic scientific, technological and human resources potential of the republic.

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

The program is aimed at training specialists in key areas of the metallurgical industry:

Types of labor activity. Specialists who have graduated from the master's degree program perform production, technological and organizational work at industrial enterprises in leading positions corresponding to the 7th level of the national qualification framework, as well as conduct research work in the field of complex processing of mineral raw materials and obtaining innovative products of increased consumer properties.

Types of economic activity: processing of ores of heavy, light, rare, refractory non-ferrous metals, uranium ores; production of energy-generating metals; processing of technogenic metallurgical raw materials; disposal of waste from metallurgical industries.

Objects of professional activity. The objects of professional activity of graduates are the existing metallurgical enterprises of ferrous and non-ferrous metallurgy, extractive metallurgy technologies aimed at transforming production on the principle of lean production, greening, obtaining energy-generating metals, as well as processing plants, chemical, mining, chemical and machine-building industries, industry research and design institutes, factory laboratories that carry out similar activity.

2. Purpose and objectives of educational program

Purpose of EP: training of personnel in the transformation of technologies to conditions of depletion of ores, increasing the volume of processed raw materials for critically important non-ferrous metals; training in the transformation of waste processing technologies in the metallurgical industry, in which they return to economic circulation in the form of renewable fuels, secondary raw materials or marketable products, the transformation of the ideology of gentle production, resource conservation at industry enterprises, reducing the "Carbon footprint" technologies; formation of competencies for obtaining energy-generating metals; management of the principles of "Green Metallurgy" according to the ESG concept and the Sustainable Development Goals (SDGs).

The Extractive Metallurgy educational program is aimed at training specialists capable of developing and implementing environmentally sound and resource-saving technologies in metallurgy within the framework of the ESG and the Sustainable Development Goals (SDGs).

The program supports several global UN goals:

1. SDG 4 – Quality Education

- Training qualified specialists in the field of extractive metallurgy.
- Developing modern educational methodologies, including digital technologies and scientific research.

2. SDG 9 – Industry, Innovation, and Infrastructure
 - Developing new technological solutions in metallurgy.
 - Implementing advanced metal processing methods.
3. SDG 12 – Responsible Consumption and Production
 - Reducing waste and minimizing the negative impact of metallurgical production.
 - Developing and implementing metal recycling technologies.
4. SDG 13 – Climate Action
 - Reducing greenhouse gas emissions in the metallurgical industry.
 - Using energy-efficient extraction and metal processing methods.

Tasks of EP:

1. Formation of theoretical knowledge and practical skills in the field of extractive gentle metallurgy, greening of existing technologies of metallurgical production, complex processing of raw materials and waste containing metals.
2. Formation of theoretical knowledge and practical skills in the field of resource-saving, lean and gentle processing of raw materials, production of products with increased added value, according to the ESG concept and the Sustainable Development Goals (SDGs).
3. Formation of theoretical knowledge and practical skills in the field of renovation of the existing technological process in the process of energy intensity, resource conservation, complexity of extraction of critical metals for the country's economy and the choice of an appropriate technological scheme.
4. Formation of competencies in the field of consumer properties of products made of energy-generating metals, innovative technologies for their production.
5. Formation of competencies in the field of scientific and technical, organizational and methodological activities and promising areas of technology development focused on the production of refractory and precious metals, rare earth and radioactive rare metals and their compounds from various types of natural and man-made raw materials.
6. Formation of competencies in the field of lean R&D development and subsequent commercialization of the project.
7. Competence of graduates in the system of digitalization of metallurgical processes. Acquisition of competencies in production management at all stages of the life cycle of manufactured products.

The Master of Technical Sciences in the field of extractive metallurgy must solve the following tasks in accordance with the types of professional activity:

research activities:

- the ability to form diagnostic solutions to professional problems by integrating the fundamental sections of sciences and interdisciplinary knowledge gained during the development of the master's degree program;
- the ability to independently conduct scientific experiments and research in the professional field, generalize and analyze experimental information, draw conclusions, formulate conclusions and recommendations, make a choice of technological schemes that contribute to the greening and resource conservation of production;

- the ability to create and explore models of the studied objects based on the use of in-depth theoretical and practical knowledge in the field of extractive metallurgy and interdisciplinary approaches to knowledge generation;

scientific and production activities:

- the ability to independently carry out production and scientific-production, laboratory and interpretation work in solving technological problems;
- the ability to professionally operate modern laboratory and technological equipment in the field of extractive metallurgy;
- the ability to use modern methods of processing and interpreting complex information to solve production problems;

project activities:

- the ability to independently draw up and submit projects of research and scientific-production works;
- readiness to design complex research and scientific-production works with the transformation of existing technologies to the principles of lean manufacturing and gentle metallurgy;

organizational and managerial activities:

- readiness to use practical skills of organization and management of research and scientific-production works in solving professional tasks;
- readiness for the practical use of regulatory documents in the planning and organization of scientific and production work;

scientific and pedagogical activity:

- ability to conduct seminars, laboratory and practical classes;
- the ability to participate in the management of scientific and educational work of students in the field of extractive metallurgy.

The educational program is fully developed to meet the objectives of the SDGs in metallurgy:

Teaching students the fundamentals of extractive metallurgy:

- Metallurgical processes for extracting metals from ores.
- Hydrometallurgical and pyrometallurgical methods.
- The latest technologies in the industry.

Developing skills in environmentally sustainable production:

- Optimizing processes to minimize emissions and waste.
- Recycling and disposal of metallurgical waste.

Preparing students for scientific and innovative activities:

- Participation in research projects.
- Development of new materials and technologies.

Collaboration with industry and international organizations:

- Internships and practical training at leading metallurgical enterprises.
- International cooperation in the field of extractive metallurgy.

Thus, the program is aimed at creating a sustainable and technologically advanced metal production industry that meets environmental safety requirements and fosters innovative development.

3. Requirements for evaluating the educational program learning outcomes

A graduate of a specialized master's degree must:

have an idea:

- about the role of science and education in public life;
- about modern trends in the development of scientific knowledge;
- about current methodological and philosophical problems of natural sciences;
- about the professional competence of a higher school teacher;
- about communicative, professional and technical language knowledge, about philosophical concepts of natural science, scientific worldview.
- about the patterns of management activities, systemic and ecological thinking, critical thinking, leadership, teamwork and communication.
- about teaching skills and mentoring undergraduate students.
- about design, research, inventive, innovative activities in the field of processing of mineral raw materials and metallurgy;
- on the principles of automation and digitalization of metallurgical processes.

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 increasing the effectiveness and quality of training;
- international and domestic standards, regulations, instructions, orders of higher and other domestic organizations, methodological normative and guidance materials relating to the work performed;
- current state and prospects for technical and technological development of enrichment and metallurgical processes, features of the activities of institutions, organizations, enterprises and related industries;
- goals and objectives facing a specialist in the field of extractive and gentle metallurgy;
- modern methods of studying enrichment and metallurgical processes, equipment operation;
- basic requirements for technical documentation, materials and products;
- rules and regulations of labor protection, issues of environmental safety of technological processes;
- methods of conducting 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:

- demonstrate communicative, professional and technical language knowledge in a foreign, professional language.
- integrate psychological patterns of management activities;
- demonstrate skills in teaching and mentoring undergraduate students;
- explore empirical data based on scientific research methodology for the ability to write articles, collect scientometric data, to protect intellectual property using the principles of project management;
- apply and implement fundamentally new schemes for obtaining metals, based on saving resources and preserving the environment, in conditions of depletion of ores, reducing the concentration of metals in ores;
- solve engineering calculations in the field of extractive metallurgy, thermodynamics and kinetics of pyro- and hydrometallurgical processes; justify the choice of processes and requirements for rectification and condensation processes;
- develop and research modern technologies for producing energy-generating, radioactive, refractory metals; carry out calculations and selection of main and auxiliary equipment for hydro-, pyro- and electrometallurgical processes in non-ferrous metallurgy, calculate and predict electro- and metallothermic production of metals and alloys;
- transform existing technologies to the principles of lean production and gentle metallurgy;
- differentiate the modern physical and chemical complex of methods for analyzing metallurgical raw materials and products, design powder materials;
- apply modern, advanced knowledge about innovative technologies for obtaining rare, rare-earth and noble metals, light and refractory metals, using resource- and energy-saving techniques for technological schemes;
- rationalize the use of critical, strategic and man-made raw materials, manage waste from metallurgical production;
- prevent and predict problems of corrosion of structures in the metallurgical industry; demonstrate awareness of the various types and types of equipment in the field of metallurgy in order to select the most optimal layout schemes and prevent structural problems;
- program, develop “MES systems” for collecting and storing data from technological processes of metallurgy.
- systematize the principles of constructing digital data processing tools, using microprocessors in control systems for technical objects and technological processes, design control systems based on microcontrollers, and develop application software.
- analyze the consumer properties of products made from energy-generating metals and apply statistical methods of quality management at production enterprises in the metallurgical industry.

have the 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, correct and logical presentation of one's thoughts in oral and written form;
- expanding and deepening the knowledge necessary for everyday professional activities and continuing education in doctoral studies.
- forming a search for economically feasible technologies and methods for reducing the emission of harmful substances into the environment;
- identification and assessment of environmental risks when conducting economic activities in metallurgical production;
- monitoring the environmental situation at deposits, enrichment and processing plants;
- determining the impact of technological processes on the ecosystem;
- application of techniques to reduce gaseous emissions from metallurgical enterprises, selection of equipment;
- gentle metallurgy when creating environmentally friendly production, methods for reducing emissions and waste from metallurgy.

be competent:

- in research and innovation-project activities;
- in technologies for producing energy-generating metals;
- in the transformation of existing technologies in the field of non-ferrous metallurgy to the principles of gentle, environmentally friendly, comprehensive processing of raw materials in conditions of depletion of ores and waste, while simultaneously digitalizing production;
- in adapting technological schemes to ore depletion;
- in the greening of metallurgical production, effective recycling of waste from the metallurgical sector;
- in increasing automation and robotization of production, increasing the degree of wear and tear of equipment in the mining and metallurgical sector;
- in matters of modern educational technologies;
- in carrying out scientific projects and research in the professional field;
- in ways to ensure constant updating of knowledge, expansion of professional skills and abilities.

4. Passport of educational program

4.1. General information

№	Field name	Comments
1	Code and classification of the field of education	7M07 – Engineering, manufacturing and construction industries
2	Code and classification of training directions	7M072 – Manufacturing and processing industries
3	Educational program group	M117 – Metallurgical Engineering
4	Educational program name	7M07232 – Extractive Metallurgy
5	Short description of	The educational program "Extractive Metallurgy" includes

	educational program	industry-specific, priority, fundamental, natural science, general engineering, practice-oriented and professional training of masters in the field of extractive metallurgy, aimed at modern, complex, resource-saving, lean and sparing processing of raw materials and production of products with increased added value, to obtain energy-generating metals in accordance with with an atlas of new professions, production requests and trends in the global metals market.
6	Purpose of EP	Training of personnel in the transformation of technologies to conditions of depletion of ores, increasing the volume of processed raw materials for critically important non-ferrous metals; training in the transformation of waste processing technologies in the metallurgical industry, in which they return to economic circulation in the form of renewable fuels, secondary raw materials or marketable products, the transformation of the ideology of gentle production, resource conservation at industry enterprises, reducing the "Carbon footprint" technologies; formation of competencies for obtaining energy-generating metals; management of the principles of "Green Metallurgy" according to the ESG concept and the Sustainable Development Goals (SDGs).
7	Type of EP	New
8	The level based on NQF	7
9	The level based on IQF	7
10	Distinctive features of EP	No
11	List of competencies of educational program	1) <i>have an idea:</i> - about the role of science and education in public life; - about modern trends in the development of scientific knowledge; - about the professional competence of a higher school teacher. 2) <i>know:</i> - methodology of scientific knowledge; - principles and structure of organizing scientific activity; - 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. 3) <i>be able to:</i> - develop energy- and resource-saving technologies in the field of mineral processing, metallurgy and metalworking; - develop measures to protect the environment for processing and metallurgical production; - plan experimental research, select research methods. 4) <i>have the skills:</i> - research activities, solving standard scientific problems; - carrying out 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 5) <i>be competent</i>: - in the field of scientific research methodology; – in the field of scientific and scientific-pedagogical activities in higher educational institutions; - in matters of modern educational technologies; - in carrying out scientific projects and research in the professional field; - in ways to ensure constant updating of knowledge, expansion of professional skills and abilities.
12	Learning outcomes of educational program	LO1 – Demonstrate communicative and professional-technical language proficiency in a foreign and professional language, as well as knowledge of philosophical concepts of natural science and scientific worldview (SDG 4). LO2 – Analyze empirical data based on scientific research methodology to develop article-writing skills, collect scientometric data, and protect intellectual property using project management principles. LO3 – Integrate psychological patterns of managerial activity, systems and ecological thinking; synthesize skills in management psychology, critical thinking, leadership, teamwork, and communication (SDG 4). LO4 – Utilize engineering calculations in extractive metallurgy to predict and optimize metallurgical processes and develop new materials based on sustainable metallurgy (SDG 12). LO5 – Apply and implement innovative technologies for the comprehensive extraction of rare, rare earth, radioactive, noble, and refractory metals in extractive metallurgy (SDG 12). LO6 – Manage and build knowledge in the field of calculating uranium conversion processes, fluoride technologies and the production of advanced composite materials based on uranium and its compounds for nuclear power, according to the clean energy concept of the (SDG 7). LO7 – Manage and build knowledge in the field of calculating uranium conversion processes, fluoride technologies and the production of advanced composite materials based on uranium and its compounds for nuclear power, according to the clean energy concept of the SDGs. LO8 – Analyze and apply technologies of liquid extraction, uranium refining, noble and rare earth metal purification, and metal refining to obtain high-purity

		metals (SDG 7). LO9 – Manage metallurgical production waste and secondary sector waste based on the principles of sustainable metallurgy, utilizing advanced thermal and plasma technologies (SDG 9). LO10 – Apply innovative powder metallurgy methods for the production of advanced and composite materials, implementing additive technologies and 3D printing of materials based on rare, rare earth, uranium, and refractory metals.
13	Education form	Full - time
14	Period of training	1,5 years
15	Amount of credits	90
16	Languages of instruction	Kazakh, russian, english
17	Academic degree awarded	Master of Engineering and Technology in the educational program «7M07232 - Extractive Metallurgy»
18	Developers and authors:	Chepushtanova T.A., Barmenshinova M.

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)									
				LO 1	LO 2	LO 3	LO 4	LO 5	LO 6	LO 7	LO 8	LO 9	LO 10
Cycle of basic disciplines University component													
LNG212	English (professional)	The course is designed for undergraduates of technical specialties to improve and develop foreign language communication skills in the professional and academic field. 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).	2	V	V	V							
HUM211	Management Psychology	The course is aimed at teaching undergraduates the basics of management psychology. It will consider the specifics of management psychology, psychological patterns of managerial activity, personality and its potential in the management system; motivation and effectiveness in the organization, leadership and leadership in modern management of organizations, social group as an object of management, psychological foundations of managerial decision-making, business communication and managerial conflicts, psychology of responsibility, image creation, how an integral part of the culture of communication, the psychology of advertising.	2		V	V							
MNG72	Management	To form a scientific understanding of management			V	V							

6		as a type of professional activity. Contents: Mastering the general theoretical principles of managing socio-economic systems; acquiring skills and abilities in practical problem-solving of managerial issues; studying global management practices and the specificities of Kazakhstani management; training in solving practical issues related to managing various aspects of organizational activities.											
Cycle of basic disciplines Elective component													
MEI248	Thermodynamics and kinetics calculations and forecasting of metallurgical processes	The study of thermodynamics, kinetics, calculations and forecasting of metallurgical processes. Mastering methods for calculating thermodynamic and kinetic parameters of processes such as smelting, metal reduction, leaching, extraction, ion exchange, electrolysis, refining and ore processing. Predicting the behavior of processes to increase their efficiency, reduce costs, and minimize environmental impacts.	4	V			V						
MEI249	Bases for obtaining alloys and composite materials with special electromagnetic and mechanical properties	The study of the basics of obtaining alloys and composite materials with special electromagnetic and mechanical properties. The basics of creating materials with special properties, as well as the principles of their selection, depending on the required performance characteristics. The study of the formation of electromagnetic and mechanical properties of materials in the creation of new alloys and materials. Technologies for the production of composite materials with improved electromagnetic and mechanical properties, including the use of nanomaterials, carbon fibers, metal-ceramic systems and other composite materials.	4	V	V								
MEI251	Extractive	The study of extractive metallurgy of rare and rare-	5	V	V								

	metallurgy of rare and rare-earth metals	earth metals. Features of technological processes used to extract rare and rare-earth metals from natural and secondary sources such as lithium, titanium, zirconium, and rare-earth elements. Thermodynamics and kinetics of processes, methods of separation and purification of metals, as well as ecology and waste management. Innovative approaches and environmental aspects, extraction and applications of rare earth metals in high-tech industries such as electronics and energy.											
MEI252	Metallurgy of uranium and technology of its compounds	The study of uranium metallurgy and the technology of its compounds. The development of methods for extracting uranium from ores, refining it, and producing various chemical compounds of uranium used in nuclear energy, industry, and scientific research. Technologies of uranium enrichment, chemical reactions of its compounds, including the production of oxides, carbides and other materials used in nuclear energy, the production of nuclear fuel, as well as environmental aspects related to the extraction and processing of uranium. The study of safety, ecology and waste management related to the extraction and processing of uranium, as well as current trends in the processing of uranium ores and the development of new technologies.	5		V	V		V					
Cycle of profile disciplines University component													
MEI253	Fundamentals of gentle metallurgy in the circular economy (in english)	The study of the basics of gentle circular metallurgy. Development of equipment layout schemes based on the balance of ecology, raw materials and energy for its processing, material flows and calculations of equipment. The study of technologies aimed at greening production (lean	5				V		V			V	

		technological schemes for the production of heavy non-ferrous metals, energy-generating metals, precious metals), utilization and burial of metallurgical waste (silicon, pyrite, arsenic-containing, mercury waste). Reducing the "Carbon footprint" of technology.											
MEI254	Waste management methods in extractive metallurgy	The study of waste management methods in extractive metallurgy. Methods of waste minimization, disposal and recycling, taking into account environmental, economic and technical factors. Waste treatment and safe disposal, as well as environmental standards and legislative requirements in the field of waste management. Consideration of the principles of sustainable development in metallurgy and the search for innovative solutions to reduce environmental impact.	5				V					V	
MEI250	Physico-chemical studies in extractive metallurgy	Application of a complex of physico-chemical analysis methods for identification of metallurgical systems and their properties. The study of methods for analyzing chemical reactions occurring during metallurgical processes, the application of thermodynamic and kinetic principles to optimize these processes. Modern analytical methods, including spectroscopy, chromatography, and other methods used to evaluate the quality and efficiency of extractive metallurgy processes are considered.	5				V	V					V
Cycle of profile disciplines Component of choice													
MEI255	Titanium and its alloys	Formation of in-depth knowledge about the physico-chemical properties of titanium, the specifics of its production, processing and application. The course examines modern methods of titanium production, classification and labeling	5					V	V				V

		of titanium alloys, analyzes their structure, phase transformations, as well as the influence of alloying and impurity elements on the performance characteristics of materials. Special attention is paid to current trends in the development of technologies for processing titanium and its alloys, as well as global market trends.											
MEI257	Refining and affinage in the metallurgy of radioactive metals	The study of refining and refining processes in metallurgy of radioactive metals. The specifics of processing radioactive elements such as uranium, thorium and others, taking into account their physico-chemical properties. To study special methods and technologies used to improve the purity of radioactive metals, as well as the specifics of working with radioactive waste. The course shows the use of radioactive metals in human economic activity. An important aspect of the course is the development of technologies that ensure safety and minimize environmental impacts during the processing of radioactive metals.	5					V			V		
MEI259	Refining technologies in extractive metallurgy	The discipline studies the methods of refining – deep purification of precious and non-ferrous metals in extractive metallurgy. Chemical, electrochemical and pyrometallurgical purification processes, recycling of secondary raw materials, as well as modern automation technologies and environmental aspects are considered. The course builds skills in the selection and optimization of refining methods in industry.	5						V		V		V
MEI260	Conversion processes of radioactive metals	The study of the conversion processes of radioactive metals (such as uranium, thorium, and others) and their compounds in order to increase their efficiency and safety in industry, including nuclear energy. The course covers methods of	5					V		V			V

		recovery, enrichment, processing and disposal of radioactive materials, as well as the processes of their conversion into more stable or useful forms. The study of various technological schemes, including methods of chemical extraction, isotope separation and radioactive waste management. Special attention is paid to optimizing these processes, taking into account environmental and technical aspects, as well as safety when working with radioactive materials.											
MEI261	Liquid extraction processes and apparatuses	The study of the theoretical foundations and practical aspects of liquid extraction processes for the extraction, concentration and separation of metals in the processing of productive and technological solutions. Special attention is paid to the use of extraction in metallurgy and in metallurgical waste processing technologies. The course covers various extraction devices such as extraction columns, centrifuges, multiphase systems, as well as process optimization methods to increase their efficiency.	5				V				V		
MEI262	Innovative technologies for the production of composite materials	The course is aimed at familiarizing oneself with the principles of creating composites, including the selection of components, methods of their combination and processing, as well as mastering methods for improving the mechanical, thermal and other properties of materials; it includes the study of modern methods for the development and production of composite materials with improved performance characteristics. The course covers the basic principles of creating composites, such as the choice of matrices and reinforcing components, as well as technologies for combining them. Important attention is also paid to the prospects of using	5							V			V

		composite materials in innovative and high-tech industries.											
MEI263	Innovative technologies in powder metallurgy	The study of the principles of powder production, their molding, sintering and processing, as well as the study of the latest developments in the field of powder metallurgy, such as 3D printing with metal powders and the use of nanopowders. Mastering methods to improve the quality and productivity of processes, as well as environmental aspects and sustainable production in powder metallurgy.	5				V		V				V
MEI264	Additive technologies in metallurgical production	The study of additive technologies in metallurgical production, such as laser powder fusion, electron beam melting and other methods used to manufacture complex metal structures with high precision and minimal waste. The study of the specifics of working with metal powders, sintering and printing processes, as well as the use of additive technologies in the development of new materials, improving characteristics and production processes. Special attention is paid to the possibilities of additive technologies in high-tech sectors of the national economy, as well as issues of economic efficiency and ecology.	5							V			V
MEI265	Innovative technologies of plasma metallurgy	The study of advanced methods and processes using plasma technologies for processing metals and creating new materials. The course covers the basics of plasma installations, such as plasma melting, metal reduction, plasma sintering and plasma surface treatment. To study the principles of creating and controlling plasma flows, as well as the methods used to improve the quality of metals and enhance their characteristics. Great attention is paid to innovative approaches such as the use of plasma for processing rare metals, processing	4						V			V	

		complex waste and producing new materials with unique properties.											
MEI256	Complex use of rare-metal and radioactive raw materials	Formation of knowledge about modern technologies used for complex processing of rare and radioactive elements, as well as for the development of combined methods for minimizing waste and improving environmental safety during their extraction and processing; issues of radioactive waste management and safety at all stages of production are considered. The course covers the development and application of effective and innovative technological schemes for processing ore and man-made raw materials to improve the extraction of useful components from metallurgical raw materials.	4				V	V			V		
MEI266	Protective coatings for the metallurgical industry	The study of coatings to protect the surface of products from various types of influences: wear, high temperatures and aggressive environments. The course examines the classification of coatings according to a number of characteristics: materials, methods of application, functional properties. The main attention is paid to the use of diffusion, gas-thermal and electroplating coatings.	5					V	V				
MEI258	Modeling and optimization of technological processes in extractive metallurgy	The study of mathematical modeling and optimization methods for analyzing and improving metal extraction and ore processing processes. The course covers the creation of thermodynamic and kinetic models of hydrometallurgy, pyrometallurgy and electrolysis processes, as well as methods for optimizing technological parameters of processes in order to increase their efficiency and reduce costs. Special attention is paid to the use of modern software and mathematical tools for calculating material balances and flows of metallurgical	5				V	V					

		production, forecasting and optimizing metallurgical processes.												
--	--	---	--	--	--	--	--	--	--	--	--	--	--	--

5. Curriculum of educational program



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

«APPROVED»
Decision of the Academic Council
NPJSC «KazNRTU»
named after K.Satbayev»
dated 20.02.2025 Minutes № 9

WORKING CURRICULUM

Academic year
Group of educational programs
Educational program
The awarded academic degree
Form and duration of study

2025-2026 (Autumn, Spring)
MI17 - "Metallurgical Engineering"
7M07232 - "Extractive metallurgy"
Master of engineering and technology
full time (professional track) - 1,5 years

Discipline code	Name of disciplines	Block	Cycle	Total ECTS credits	Total hours	lek/lab/pr Contact hours	in hours SIS (including TSIS)	Form of control	Allocation of face-to-face training based on courses and semesters			Prerequisites
									1 course		2 course	
									1 sem	2 sem	3 sem	
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)												
CYCLE OF BASIC DISCIPLINES (BD)												
M-1. Module of basic training												
LNG212	Foreign language (professional)		BD, UC	2	60	0:0:30	30	E	2			
MNG726	Management		BD, UC	2	60	15:0:15	30	E	2			
HUM211	Psychology of management		BD, UC	2	60	15:0:15	30	E	2			
MEI248	Thermodynamics and kinetics calculations and forecasting of metallurgical processes	1	BD, CCH	4	120	30:0:15	75	E	4			
MEI249	Bases for obtaining alloys and composite materials with special electromagnetic and mechanical properties	1	BD, CCH	4	120	30:15:0	75	E	4			
MEI251	Extractive metallurgy of rare and rare-earth metals	2	BD, CCH	5	150	30:0:15	105	E	5			
MEI252	Metallurgy of uranium and technology of its compounds	2	BD, CCH	5	150	30:0:15	105	E	5			
CYCLE OF PROFILE DISCIPLINES (PD)												
M-2. Module of professional activity												
MEI250	Physico-chemical studies in extractive metallurgy		PD, UC	5	150	30:0:15	105	E	5			
MEI253	Fundamentals of gentle metallurgy in the circular economy		PD, UC	5	150	30:0:15	105	E	5			
MEI254	Waste management methods in extractive metallurgy		PD, UC	5	150	30:0:15	105	E	5			
MEI255	Titanium and its alloys	1	PD, CCH	5	150	30:0:15	105	E		5		
MEI257	Refining and refining in metallurgy of radioactive metals	1	PD, CCH	5	150	30:0:15	105	E		5		
MEI259	Refining technologies in extractive metallurgy	2	PD, CCH	5	150	30:0:15	105	E		5		
MEI260	Conversion processes of radioactive metals	2	PD, CCH	5	150	30:0:15	105	E		5		
MEI261	Liquid extraction processes and apparatuses	3	PD, CCH	5	150	30:0:15	105	E		5		
MEI262	Innovative technologies for the production of composite materials	3	PD, CCH	5	150	30:0:15	105	E		5		
MEI263	Innovative technologies in powder metallurgy	4	PD, CCH	5	150	30:0:15	105	E		5		
MEI264	Additive technologies in metallurgical production	4	PD, CCH	5	150	30:0:15	105	E		5		
MEI266	Protective coatings for the metallurgical industry	5	PD, CCH	5	150	30:15:0	105	E		5		
MEI258	Modeling and optimization of technological processes in extractive metallurgy	5	PD, CCH	5	150	30:0:15	105	E		5		
MEI265	Innovative technologies of plasma metallurgy	1	PD, CCH	4	120	30:0:15	75	E			4	
MEI256	Complex use of rare-metal and radioactive raw materials	1	PD, CCH	4	120	30:0:15	75	E			4	
M-3. Practice-oriented module												
AAP248	Internship		PD, UC	5				R		5		
M-4. Experimental and research module												

AAP249	Experimental research work of a master student, including an internship and the implementation of a master's project	ERWMS	18				R			18	
M-5. Module of final attestation											
ECA213	Design and defense of the master's project	FA	8							8	
Total based on UNIVERSITY:								30	30	30	
								60		30	

Number of credits for the entire period of study

Cycle code	Cycles of disciplines	Credits			
		Required component (RC)	University component (UC)	Component of choice (CCH)	Total
GED	Cycle of general education disciplines	0	0	0	0
BD	Cycle of basic disciplines	0	6	9	15
PD	Cycle of profile disciplines	0	20	29	49
Total for theoretical training:		0	26	38	64
RWMS	Research Work of Master's Student				0
ERWMS	Experimental Research Work of Master's Student				18
FA	Final attestation				8
TOTAL:					90

Decision of the Educational and Methodological Council of KazNRTU named after K.Satpayev. Minutes № 4 dated 03.02.2025

Decision of the Academic Council of the Institute. Minutes № 5 dated 23.01.2025

Signed:

Governing Board member - Vice-Rector for Academic Affairs

Uskenbayeva R. K.

Approved:

Vice Provost on academic development

Kalpeyeva Z. I.

Head of Department - Department of Educational Program
Management and Academic-Methodological Work

Zhumagaliyeva A. S.

Director - Mining and Metallurgical Institute named after
O.A. Baikunurov

Rysbekov K. .

Department Chair - Metallurgy and mineral processing

Barmenshinova M. .

Representative of the Academic Committee from Employers

Ospanov Y. A.

____Acknowledged____

