Mining and Metallurgical Institute named after O.A. Baikonurov

Department of Metallurgy and Mineral Processing
Department of Metallurgical processes, heat engineering and technology of special materials

EDUCATIONAL PROGRAM

8D07204 - Metallurgical engineering

Code and classification of the field of education	8D07 – Engineering, manufacturing and construction industries
Code and classification of training directions	8D072 – Industrial and manufacturing branches
Educational program group	D117 – Metallurgical engineering
The level based on NQF	Level 8 – Postgraduate education (programs leading to the academic degree of Doctor of Philosophy (PhD) and doctors in profile and/or practical experience)
The level based on IQF	Level 8 – Knowledge at the most advanced level in the field of science and professional activity
Period of training	3 years
Amount of credits	180

Almaty 2024

Educational program **«8D07204 - Metallurgical engineering»**

was approved at the meeting of K.I. Satbayev KazNRTU Academic Council.

Minutes № 12 dated «22» 04 2024

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

Minutes № 6 dated «19» 04 2024.

Educational program **8D07204 - Metallurgical engineering** was developed by Academic committee based on direction **«Metallurgical engineering»**

Full name	Academic degree/ academic title	Position	Workplace	Signature
Chairperson of Academic Committee:				
Barmenshinova Madina	Candidate of Technical Sciences, Associate Professor	Head of the Department of MaMP	KazNRTU	
Chepushtanova Tatyana	PhD, Candidate of Technical Sciences, Associate Professor	Head of the Department of MPHaTSM	KazNRTU	
Teaching staff:				
Baimbetov Bolotpay	Candidate of Technical Sciences	Professor of the Department of MaMP	KazNRTU	
Ussoltseva Galina	Candidate of Technical Sciences	Associate Professor of the Department of MPHaTSM	KazNRTU	
Employers:				
Yerzhan Ospanov	Doctor of technical sciences	Head of the Department for Integrated Processing of Technogenic Raw Materials	«Kazakhmys Corporation» LLP	
Students				
Baisultanov Rinat	Master of Technical Sciences	Doctoral candidate	KazNRTU	

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List of abbreviations and designations

SMSERK – The State mandatory standard of Education of the Republic of Kazakhstan;

MEaS RK – Ministry of Education and Science of the Republic of Kazakhstan;

EP – educational program;

SIS – independent work of a student (student, master's student, doctoral student);

TSIS – independent work of a student with a teacher (independent work of a student (master's student, doctoral student) with a teacher);

WC – working curriculum;

CES – catalog of elective subjects;

UC – the university component;

CC – component of choice;

NQF – national qualifications framework;

IQF – industry qualifications framework;

LO – learning outcomes;

KC – key competencies.

1. Description of educational program

It is intended for the implementation of specialized bachelor's degree training in the educational program "8D07204 – Metallurgical Engineering" at Satbayev University and was developed within the framework of the direction "Manufacturing and processing industries".

Specialty 8D07204 – Metallurgical Engineering" is accredited by the International Agency of the National Academy of Sciences (Kazakhstan). A distinctive feature of the doctoral program is that the educational program provides international training for specialists of the highest category, capable of independently conducting research and innovation and project activities, conducting high-tech business, capable of being leaders in world-class scientometric indicators. The program is accredited by the NAAR (Kazakhstan). The educational program provides knowledge in the field of development and implementation of metallurgical technologies, production of innovative metallurgical products, increased consumer properties; graduates have high leadership and organizational qualities; are capable of creating small knowledge-intensive metallurgical businesses.

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

– The Law of the Republic of Kazakhstan "On Education" with amendments and additions in the framework of legislative amendments to enhance the independence and autonomy of universities dated 04.07.18 №171-VI;

– The Law of the Republic of Kazakhstan "On Amendments and Additions to Certain Legislative Acts of the Republic of Kazakhstan on the expansion of academic and managerial independence of higher education institutions" dated 07/04/18, No. 171-VI;

– Order of the Minister of Education and Science of the Republic of Kazakhstan dated 10/30/18, No. 595 "On approval of Standard Rules for the activities of educational organizations of appropriate types";

– The State mandatory standard of higher education (Appendix 7 to the Order of the Minister of Education and Science of the Republic of Kazakhstan dated 31.10.18 №604;

– Resolution of the Government of the Republic of Kazakhstan dated January 19, 12, No. 111 "On approval of the Standard Rules for admission to study in educational organizations implementing educational programs of higher education" with amendments and additions dated July 14, 2016, No. 405;

– Resolution of the Government of the Republic of Kazakhstan dated December 27, 2019 No. 988 "On approval of the State Program for the Development of Education and Science of the Republic of Kazakhstan for 2020-2025";

– Resolution of the Government of the Republic of Kazakhstan dated December 31, 2019 No. 1050 "On approval of the State Program of Industrial and Innovative Development of the Republic of Kazakhstan for 2020-2025";

– "National Qualifications Framework", approved by the Protocol of the Republican Tripartite Commission on Social Partnership and Regulation of Social and Labor Relations dated 06/16/2016;

– Industry Qualifications Framework "Mining and Metallurgical Complex" dated 07/30/2019 No. 1;

– Strategy "Kazakhstan-2050": a new political course of the established state. The Message of the President of the Republic of Kazakhstan - Leader of the Nation N.A. Nazarbayev to the people of Kazakhstan. Astana, 12/14/2012;

– "New development opportunities in the context of the Fourth Industrial Revolution". The Message of the President of the Republic of Kazakhstan N. Nazarbayev to the people of Kazakhstan. 10.01.2018;

– "The third modernization of Kazakhstan: global competitiveness". The Message of the President of the Republic of Kazakhstan N.Nazarbayev to the people of Kazakhstan. 31.01.2017

Introduction to the educational program. The development of an innovative economy initially forms the so–called double spirals of interaction - between universities (science) and business, business and government, etc., which then form a "triple spiral". Within the framework of the triple helix model, interdisciplinary knowledge is generated, developed by interdisciplinary teams united for a short period of time to work on a specific problem in the real world. In the triple helix model, universities, along with their educational and research functions, additionally increase their entrepreneurial functions by actively participating in the development 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 deep training of specialists in narrowly focused specialization, has led to the emergence of interdisciplinary barriers and hindered the development of new "growth points" that are located at the junctions of disciplines.

Modern needs require graduates not only to have in-depth knowledge in their chosen field of science, but also to understand the mechanisms and tools for 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, and the effective use of the republic's domestic scientific, technological and human resources potential.

The program is comprehensive and knowledge-intensive. The effectiveness 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 activities 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 for a coherent and flexible system of training advanced scientific and innovative personnel, combining deep fundamental knowledge with a broad scientific outlook and the ability to independently conduct research with a comprehensive understanding of the main problems in the mining and metallurgical industry.

Types of work activity. Specialists who have completed their doctoral studies carry out production, technological and organizational work at industrial enterprises in leading positions corresponding to the 8th level of the national qualification framework, as well as conduct research in the field of complex processing of mineral raw materials and obtaining innovative products with increased consumer properties.

Types of economic activity: metal ore mining; iron ore mining; underground iron ore mining; open-pit iron ore mining; non-ferrous metal ore mining; uranium and thorium ore mining; uranium and thorium ore mining; other non-ferrous metal ores mining; extraction and processing of aluminum-containing raw materials; extraction and processing of copper ore; mining and processing of lead-zinc ore; mining and processing of nickel-cobalt ores; mining and processing of titanium-magnesium raw materials (ores); mining and processing of tin ore; mining and processing of antimony-mercury ores; mining of precious metals and ores of rare metals; mining of other non-ferrous metals.

Objects of professional activity. The objects of professional activity of graduates are enrichment plants, enterprises of ferrous and non-ferrous metallurgy, chemical, mining, chemical and machine-building industries, branch research and design institutes, factory laboratories, higher educational institutions, consulting companies, scientific and innovation centers, banks.

Professional competence: design, engineering, design and research activities, improvement and optimization of metallurgical industries. Implementation of the development and implementation of technological processes for processing mineral, natural and man-made raw materials. Assessment of innovation and technological risks in the implementation of new technologies. Competence in marketing high-tech technologies. The skills of setting tasks and

problems, their systematic solutions using innovative approaches, methods of building concepts and strategies of activity. Systemic and strategic thinking, skills of making mutually beneficial decisions using logical methods, building and reproducing models of professional activity and interaction in the metallurgical industry.

2 Purpose and objectives of educational program

The purpose: training of highly qualified specialists with core competencies in solving organizational and production tasks in the implementation of innovative projects in the field of metallurgy; training of personnel for the innovative economy in metallurgy, covering modern energy-saving technologies, design activities, innovative solutions, entrepreneurship in the high-tech sector. The educational program is aimed at graduates implementing their developments in production and commercialization, as well as the scientific results obtained.

The objectives of the OP "8D07204 – Metallurgical Engineering" are

– to train professionals in analytical, consulting and research activities;

– independent conduct of research, R&D, and any design activity in the field of metallurgy; compliance with international engineering qualifications;

– training of specialists to carry out pedagogical activities in higher education institutions in the metallurgical field;

– retraining and advanced training of specialists and managers of non-ferrous metallurgy;

– acquisition of knowledge on energy-intensive, innovative technologies in the metallurgical sector, nanotechnology, technologies that meet the requirements of the "green economy" in metallurgy, advanced methods of physico-chemical analysis, software operation in calculations of various metallurgical, thermodynamic, kinetic systems, obtaining special-purpose products; development of design solutions;

– assessment of innovation and technological risks in the implementation of new technologies;

– competence in marketing high-tech technologies;

– development of personal scientometric indicators of the student;

– international internship.

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

3. Requirements for evaluating the educational program learning outcomes

Persons who have received a PhD degree, in order to deepen their scientific knowledge, solve scientific and applied problems on a specialized topic, carry out a postdoctoral program or conduct scientific research under the guidance of a leading scientist of a chosen university.

A graduate of a scientific and pedagogical doctoral program must:

1) have an idea of:

– the main stages of development and paradigm shift in the evolution of science;

– on the subject, ideological and methodological specifics of the natural (social, humanitarian, economic) sciences;

– about scientific schools of the relevant branch of knowledge, their theoretical and practical developments;

– about scientific concepts of world and Kazakh science in the relevant field;

– on the mechanism of implementation of scientific developments in practical activities;

– on the norms of interaction in the scientific community;

– about the pedagogical and scientific ethics of a research scientist;

2) know and understand:

– current trends, trends and patterns of development of Russian science in the context of globalization and internationalization;

– methodology of scientific knowledge;

– achievements of world and Kazakh science in the relevant field;

– (realize and accept) the social responsibility of science and education;

– perfect foreign language for scientific communication and international cooperation;

3) be able to:

– to organize, plan and implement the scientific research process;

– analyze, evaluate and compare various theoretical concepts in the field of research and draw conclusions;

– analyze and process information from various sources;

– to conduct independent scientific research, characterized by academic integrity, based on modern theories and methods of analysis;

– generate your own new scientific ideas, communicate your knowledge and ideas to the scientific community, expanding the boundaries of scientific knowledge;

– to choose and effectively use modern research methodology;

– plan and predict your further professional development;

4) have the skills:

– critical analysis, evaluation and comparison of various scientific theories and ideas;

– analytical and experimental scientific activities;

– planning and forecasting of research results;

– public speaking and public speaking at international scientific forums, conferences and seminars;

– scientific writing and scientific communication;

– planning, coordinating and implementing scientific research processes;

– a systematic understanding of the field of study and demonstrate the quality and effectiveness of selected scientific methods;

– participation in scientific events, fundamental scientific domestic and international projects;

– leadership management and team management;

– responsible and creative attitude to scientific and scientific-pedagogical activities;

– conducting patent search and experience in the transfer of scientific information using modern information and innovative technologies;

- protection of intellectual property rights for scientific discoveries and developments;

– free communication in a foreign language;

5) be competent:

– in the field of scientific and scientific-pedagogical activity in conditions of rapid updating and growth of information flows;

– in carrying out theoretical and experimental scientific research;

– in setting and solving theoretical and applied problems in scientific research;

– to conduct a professional and comprehensive analysis of problems in the relevant field;

– in matters of interpersonal communication and human resource management;

– in matters of university training of specialists;

– in carrying out the expertise of scientific projects and research;

to ensure continuous professional growth.

4. Passport of educational program

4.1. General information

№	Field name	Comments
1	Code and classification of the field of education	8D07 – Engineering, manufacturing and construction industries
2	Code and classification of training directions	8D072 – Industrial and manufacturing branches
3	Educational program group	D117 – Metallurgical Engineering
4	Educational program name	"8D07204 - Metallurgical engineering"
5	Short description of educational program	The educational program "8D07204 - Metallurgical Engineering" includes fundamental, natural science, general engineering and professional PhD training in the field of metallurgical engineering in accordance with the development of science and technology, as well as the changing needs of the mining and metallurgical and mining processing industries.
6	Purpose of EP	Training of competitive personnel with critical thinking, fundamental and applied knowledge, scientific and research skills in the field of metallurgy, capable of making comprehensive and effective decisions in the processing of mineral raw materials from concentrates to metals and their compounds
7	Type of EP	Current

8	The level based on NQF	Level 8 – Postgraduate education (programs leading to the academic degree of Doctor of Philosophy (PhD) and doctors in profile and/or practical experience)
9	The level based on IQF	Level 8 – Knowledge at the most advanced level in the field of science and professional activity
10	Distinctive features of EP	A distinctive feature of the doctoral program is that the educational program provides international training for specialists of the highest category, capable of independently conducting research and innovation and project activities, conducting high-tech business, capable of being leaders in world-class scientometric indicators. The program is accredited by the NAAR (Kazakhstan).
11	List of competencies of educational program	*1) have an idea of:* – the main stages of development and paradigm shift in the evolution of science; – on the subject, ideological and methodological specifics of the natural (social, humanitarian, economic) sciences; – about scientific schools of the relevant branch of knowledge, their theoretical and practical developments; – about scientific concepts of world and Kazakh science in the relevant field; – on the mechanism of implementation of scientific developments in practical activities; – on the norms of interaction in the scientific community; – about the pedagogical and scientific ethics of a research scientist; *2) know and understand:* – current trends, trends and patterns of development of Russian science in the context of globalization and internationalization; – methodology of scientific knowledge; – achievements of world and Kazakh science in the relevant field; – (realize and accept) the social responsibility of science and education; – perfect foreign language for scientific communication and international cooperation; *3) be able to:* – to organize, plan and implement the scientific research process; – analyze, evaluate and compare various theoretical concepts in the field of research and draw conclusions; – analyze and process information from various sources; – to conduct independent scientific research, characterized by academic integrity, based on modern theories and methods of analysis; – generate your own new scientific ideas, communicate your knowledge and ideas to the scientific community, expanding the boundaries of scientific knowledge; – to choose and effectively use modern research methodology; – plan and predict your further professional development; *4) have the skills:* – critical analysis, evaluation and comparison of various scientific theories and ideas; – analytical and experimental scientific activities;

		– planning and forecasting of research results; – public speaking and public speaking at international scientific forums, conferences and seminars; – scientific writing and scientific communication; – planning, coordinating and implementing scientific research processes; – a systematic understanding of the field of study and demonstrate the quality and effectiveness of selected scientific methods; – participation in scientific events, fundamental scientific domestic and international projects; – leadership management and team management; – responsible and creative attitude to scientific and scientific-pedagogical activities; – conducting patent search and experience in the transfer of scientific information using modern information and innovative technologies; - protection of intellectual property rights for scientific discoveries and developments; – free communication in a foreign language; *5) be competent:* – in the field of scientific and scientific-pedagogical activity in conditions of rapid updating and growth of information flows; – in carrying out theoretical and experimental scientific research; – in setting and solving theoretical and applied problems in scientific research; – to conduct a professional and comprehensive analysis of problems in the relevant field; – in matters of interpersonal communication and human resource management; – in matters of university training of specialists; – in carrying out the expertise of scientific projects and research; to ensure continuous professional growth.
12	Learning outcomes of educational program	LO1 - they possess knowledge, skills and abilities to manage information, carry out complex monitoring, analysis and synthesis, strive for continuous improvement of research culture; possess the basic laws of basic disciplines in application to the description and modeling of technological processes of metallurgy. LO2 - they possess knowledge in the field of theoretical bases of rational use of natural resources, processing of raw materials and products, skills and abilities to rebuild professional activity, to implement author's innovative ideas in education, to find non-standard and alternative solutions, are capable of generating new ideas, to critical thinking. LO3 - they are able to use fundamental General engineering knowledge; they are able to critically comprehend the accumulated experience, change the profile of their professional activity if necessary; they know how to combine theory and practice to solve engineering problems LO4 - they are able to apply applied software and modern methods of information processing

		LO5 - possess a system of subject and methodological knowledge, skills and application of theoretical knowledge in professional activities in the field of metallurgy; possess knowledge in the field of scientific and technical innovation, skills and abilities of search, assessment, selection of information, capable of innovation. LO6 - independently conduct scientific search of necessary new information on technological processes in the field of metallurgy for purposeful use of their scientific purposes.
13	Education form	Full-time
14	Period of training	3 years
15	Amount of credits	180
16	Languages of instruction	Kazakh/Russian
17	Academic degree awarded	PhD doctor
18	Developer(s) and authors	Chepushtanova T.A., Barmenshinova M.B.

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

№	Discipline name	Short description of discipline	Amount of credits	Generated learning outcomes (codes)					
				PO1	PO 2	PO 3	PO 4	PO 5	PO 6
Cycle of basic disciplines University component									
MET322	Methods of scientific research	Purpose: It consists in mastering knowledge about the laws, principles, concepts, terminology, content, specific features of the organization and management of scientific research using modern methods of scientometry. Contents: structure of technical sciences, application of general scientific, philosophical and special methods of scientific research, principles of organization of scientific research, methodological features of modern science, ways of development of science and scientific research, the role of technical sciences, computer science and engineering research in theory and practice.	5		V	V	V		
LNG305	Academic writing	Objective: to develop academic writing skills and writing strategies for doctoral students in engineering and natural sciences. Content: fundamentals and general principles of academic writing, including: writing effective sentences and paragraphs, writing an abstract, introduction, conclusion, discussion, and references; in-text citation; preventing plagiarism; and preparing a conference presentation.	5		V	V	V		
Cycle of basic disciplines Component of choice									
MET309	Scientific research of the processes of complex extraction of metals from the	Purpose: To form modern ideas and master the physico-chemical foundations of the basic laws of interaction of components in molten media, aqueous solutions, gas phases occurring during	5	V			V	V	V

	industrial mining and metallurgical complex	metallurgical processing of non-traditional raw materials: poor, difficult-to-enrich, complex polymetallic ores. Content: New solutions, methods of processing substandard raw materials with additional extraction of metals from them from the point of view of technology and new requirements for environmental safety and environmental protection. New approaches of the theoretical basis necessary for the development of innovative technologies for the production of non-ferrous metals from non-traditional types of raw materials and waste.							
MET311	Modern trends in the development of theory and technology of metallurgical production	Purpose: To develop doctoral students' professional competence in the analysis of modern technologies, the development of new technologies, the formulation and conduct of research and development work. Content: the course is the current state and trends in the development of the raw material base of metal production. The level of development of technology and equipment in metallurgy. Familiarization with new technological schemes for processing raw materials containing non-ferrous and ferrous metals. Analysis of the principles and patterns of the main processes in metallurgy using new research methods.	5		V		V		V
MNG349	Intellectual property and the global market	Purpose: the goal is to train specialists in the field of intellectual property law who can analyze and predict trends in its development in the global market, develop strategies for the protection and commercialization of intellectual property. Contents: global aspects of intellectual property and its role in international trade and economics, analysis of international agreements and							

		conventions, IP management strategies, cases of protection and violation of intellectual property rights in various jurisdictions.							
Cycle of profile disciplines Component of choice									
MET308	Innovative technologies for the production of new types of products from waste and recycled raw materials of non-ferrous metallurgy	Purpose: To study the theory and technology of modern new processes for processing man-made waste and secondary raw materials of non-ferrous metallurgy to obtain new types of products. Content: Characteristics of substandard raw materials: poor, difficult-to-enrich, complex polymetallic ores; man-made waste from metallurgy, chemical industry and energy; secondary raw materials. New technologies for the complex extraction of non-ferrous metals and valuable components from substandard raw materials. The physico-chemical foundations of innovative technologies for processing slag waste, substandard intermediates and recycled materials, including the extraction of base metals and the expansion of the range of new types of marketable products.	5	V					
MET313	Technologies of production of nanopowders, nanomaterials and composite materials	Purpose: To study the methods of obtaining composite materials. Physico-chemical bases for the production of composite materials. Nanoscale powders. Physico-chemical bases of electrochemical methods for the production of nanoparticles. Contents: Experimental study of the electrophysical parameters of carbon nanopowders. Volt-ampere characteristics of a carbon nanostructured composite. Investigation of the properties of the obtained materials. Numerical study of powder dispersion based on computer modeling. Development of technology for the production of nanostructured							

		materials based on carbon nanopowders. The formation of a new phase. Preparation of suspensions of low-dimensional coal powders using the method of hydraulic fractionation. Nanosuspensions based on low-dimensional carbon particles.							
MET314	Research methods	Purpose: It consists in mastering knowledge about the laws, principles, concepts, terminology, content, specific features of the organization and management of scientific research using modern methods of scientometry. Contents: structure of technical sciences, application of general scientific, philosophical and special methods of scientific research, principles of organization of scientific research, methodological features of modern science, ways of development of science and scientific research, the role of technical sciences, computer science and engineering research in theory and practice.							
MET323	Complexation in metallurgical systems and processes	Purpose: to obtain knowledge by doctoral students on the chemistry of coordination compounds, on the nature of the chemical bond in coordination compounds and their structure. Contents: Gaining knowledge on the chemistry of complex compounds (CS), the nature of the chemical bond in CS, their structure, transformations in solutions and solid phase; the main directions of CS use in industry, science and technology.	5		V				

5 Curriculum of educational program

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

SATBAYEV UNIVERSITY

APPROVED
Chairman of the Management Board -
Rector of KazNTU named after K.Satpayev
M.M. Begentaev
"22" 04 2024 y.

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

Educational program 8D07204 - "Metallurgical engineering"
Group of educational programs D117 - "Metallurgical engineering"

Form of study: full-time | Duration of study: 3 year | Academic degree: Doctor of Philosophy PhD

Discipline code	Name of disciplines	Cycle	Total volume in academic classes	Total amount in academic credits	Total hours	Classroom amount lec/lab/pr	SIS (including TSIS) in hours	Form of control	Allocation of face-to-face training based on courses and semesters					
									1 course		2 course		3 course	
									1 semester	2 semester	3 semester	4 semester	5 semester	6 semester
CYCLE OF BASIC DISCIPLINES (BD)														
M-1. Module of basic training (university component)														
MET322	Scientific research methods	BD UC	3	5	150	2/0/1	105	E	5					
LNG305	Academic writing	BD UC	3	5	150	0/0/3	105	E	5					
component of choice														
MET309	Scientific research of the processes of complex extraction of metals from the industrial mining and metallurgical complex	BD CCH	3	5	150	2/0/1	105	E	5					
MET311	Modern trends in the development of theory and technology of metallurgical production													
MNG349	Intellectual property and the global market													
CYCLE OF PROFILE DISCIPLINES (PD)														
M-2. Module of professional activity (component of choice)														
MET308	Innovative technologies for the production of new types of products from waste and recycled raw materials of non-ferrous metallurgy	PD, CCH	3	5	150	2/0/1	105	E	5					
MET313	Technologies of production of nanopowders, nanomaterials and composite materials													
MET314	Increasing the efficiency of extraction extraction of non-ferrous metals	PD, CCH	3	5	150	2/0/1	105	E	5					
MET323	Complexation in metallurgical systems and processes													
M-3. Practice-oriented module														
AAP350	Pedagogical practice	BD UC	10	10						10				
AAP355	Research practice	PD UC	10	10							10			
M-4. Experimental research module														
AAP336	Research work of a doctoral candidate, including internships and completion of a doctoral dissertation	RWDS UC	5	5					5					
AAP347	Research work of a doctoral candidate, including internships and completion of a doctoral dissertation	RWDS UC	40	40						20	20			
AAP356	Research work of a doctoral candidate, including internships and completion of a doctoral dissertation	RWDS UC	60	60								30	30	
AAP348	Research work of a doctoral candidate, including internships and completion of a doctoral dissertation	RWDS UC	18	18										18
M-5. Module of final attestation														
ECA303	Writing and defending a doctoral dissertation	FA	12	12										12
	Total based on UNIVERSITY:								30	30	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	5	25
PD	Cycle of profile disciplines		10	10	20
	Total for theoretical training:	*0*	*30*	*15*	*45*
	RWDS	123			123
FA	Final attestation	12			12
	TOTAL:	135	30	15	180

Decision of the Academic Council of KazNRTU named after K.Satpayev. Protocol № 12 от "22" 04 2024 y.

Decision of the Educational and Methodological Council of KazNRTU named after K.Satpayev. Protocol № 6 от "19" 04 2024 y.

Decision of the Academic Council of MaMI named after O. Baikonurov. Protocol № 7 от "27" 03 2024 y.

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

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