Mining and Metallurgical Institute named after O.A. Baikonurov
Department «Metallurgy and mineral processing»

EDUCATIONAL PROGRAM

6B07219 – Metallurgy of non-ferrous metals

Code and classification of the field of education:	6B07 - Engineering, manufacturing and construction industries
Code and classification of areas of study:	6B072 - Manufacturing and processing industries
Group of educational programs:	B071 - "Mining and extraction of minerals"
NQF level:	Level 6 - higher education and practical experience
ORC level:	Level 6 - a wide range of special (theoretical and practical) knowledge (including innovative). Independent search, analysis and evaluation of professional information
Training period:	4 years
Volume of loans:	240

Almaty 2024

The education program «6B07219 – Metallurgy of non-ferrous metals» was approved at a meeting Academic Council of KazNRTU named after K.I. Satpayev.

Protocol No. 12 dated «22» 04 2024

Reviewed and recommended for approval at a meeting of the Educational and Methodological Council of KazNRTU named after K.I. Satpayev.

Protocol No. 6 dated «19» 04 2024

The educational program «6B07219 – Metallurgy of non-ferrous metals» was developed by the academic committee in the direction of «Manufacturing and processing industries».

Full name	Academic degree/ academic title	Job title	Place of work	Signature
Chairman of the Academic Committee:				
Barmenshinova M.B.	c.t.s., associate professor	Head of the Department of MaMP	KazNRTU named after K.I. Satpayev	
Teaching staff:				
Baimbetov B.S.	c.t.s., docent	Professor of the Department of MaMP	KazNRTU named after K.I. Satpayev	
Moldabaeva G.Zh.	c.t.s.	Associate professor	KazNRTU named after K.I. Satpayev	
Employers:				
Ospanov E.A.	Doctor of Technical Sciences	Head of the Department of Complex processing of technogenic raw materials	«Kazakhmys Corporation» LLP	
Students:				
Zholybaeva D.E.		3rd year student	KazNRTU named after K.I.Satpaeva	

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List of abbreviations and symbols

NJSC «Kazakh National Research Technical University named after K.I. Satpayev» - NJSC KazNRTU named after K.I. Satpayev;

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

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

EP - educational program;

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

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

WC - working curriculum;

CED - catalog of elective disciplines;

UC - university component;

CC - component of choice;

NQF - National Qualifications Framework;

SQF - Sectoral Qualifications Framework;

LO - learning outcomes;

KC - key competencies;

SDG -Sustainable Development Goals.

1. Description of the educational program

It is intended for implementation of profile training of bachelors on educational program 6B07219 - "Metallurgy of non-ferrous metals" at Satbayev University and developed within the framework of the direction "Production and processing industries".

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 within the framework of legislative changes to increase the independence and autonomy of universities dated 04.07.18 No. 171-VI;

– The Law of the Republic of Kazakhstan «On Amendments and Additions to Some Legislative Acts of the Republic of Kazakhstan on the expansion of academic and managerial independence of higher educational institutions» dated 04.07.18 No. 171-VI;

– Order of the Minister of Education and Science of the Republic of Kazakhstan dated 30.10.18 No. 595 «On approval of Standard rules for the activities of educational organizations of appropriate types»;

– 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 No. 604;

– Resolution of the Government of the Republic of Kazakhstan dated 19.01.12 No. 111 «On approval of Standard rules for admission to education organizations implementing educational programs of higher education» with amendments and additions dated 14.07.16 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 31.12.2019 No. 1050 «On approval of the State Program of Industrial and innovative Development of the Republic of Kazakhstan for 2020-2025»;

– «National Qualifications Framework» approved by the Protocol of 16.06.2016 by the Republican Tripartite Commission on Social Partnership and Regulation of Social and Labor Relations;

– Industry Qualifications Framework "Mining and Metallurgical Complex" dated 30.07.2019 No. 1;

– Strategy «Kazakhstan-2050»: a new political course of the established state. Message of the President of the Republic of Kazakhstan - Leader of the Nation N.A. Nazarbayev to the people of Kazakhstan. Astana, 14.12.2012;

– «New development opportunities in the context of the Fourth Industrial Revolution». 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». 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 helices of interaction - between universities (science) and business, business and government, etc., which then form a «triple spiral». Within the framework of the triple helix model, interdisciplinary knowledge is generated, developed by interdisciplinary teams united for a short time to work on a specific problem of the real world. In the triple helix model, universities, along with educational and research functions, additionally increase entrepreneurial functions by actively participating in the cultivation of startups together with industry, stimulated by the state.

The concept of this scientific and educational program is based on the triple helix model, which involves the creation of innovative solutions based on interdisciplinary research and educational programs (Figure 1).

Figure 1 - The concept of scientific and educational programs

The previously established structure of education, based on in-depth training of specialists in narrowly focused specialization, has led to the emergence of interdisciplinary barriers and hindering the development of new "growth points" that are located at the junctions of disciplines.

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

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

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

The program is 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 the high-tech sectors of the economy of the Republic of Kazakhstan based on the development of priority areas of science and technology, development of knowledge-intensive industries, competitive technologies in the processing of technogenic raw materials and waste; capable of developing innovative technologies that minimize environmental damage and implement advanced methods of processing non-ferrous metals within the framework of the principles of sustainable development.

The developed Program is the basis for a coherent and flexible system of training of 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 benefits of the Program are:

- active involvement of talented students in priority research (fundamental) and scientific and technical (applied) works;
- student participation in priority scientific works, formation of new knowledge and skills, acquisition of professional work experience (seniority) to continue scientific research in master's and doctoral programs with the development of innovative technologies for the mining and metallurgical industry.

Training of specialists provides training in the main directions, each of which includes modern fundamental content necessary for training of highly qualified specialists demanded by the economy of the republic.

Educational program 6B07219 - "Non-ferrous Metallurgy" includes fundamental, natural science, general engineering and professional training of bachelors in the field of non-ferrous metallurgy in accordance with the development of science and technology, as well as the changing needs of the mining and metallurgical industry.

The distinctive feature of the program is that the program provides adaptation of the graduate to the industrial sector, due to the content of 40% of general engineering disciplines in the educational program.

The graduate receives a fundamental set of general engineering disciplines as well as a maximum set of specialized disciplines.

The program provides in-depth study of technological mineralogy, basics of mineral processing, general metallurgy, theory of metallurgical processes, metallurgy of heavy non-ferrous, noble, light, rare and disseminated metals, metallurgical heat engineering, metallurgical engineering (in English), heat and power engineering of metallurgical processes, alloying of non-ferrous metals, organization and planning of experiments, modern environmental schemes and forecasting in metallurgy.

The area of professional activity of graduates who have mastered the Bachelor's degree program includes:

- processes of beneficiation and processing of ores and other materials to produce concentrates and intermediates;

- processes of obtaining metals and alloys, metal products of required quality;

- Processing processes that change the chemical composition and structure of metals (alloys) to achieve certain properties.

A graduate of the program will be able to perform professional activities in the mining and metallurgical complex in engineering and working positions, at metallurgical enterprises, in design organizations, in metallurgical research centers.

Objects of professional activity of graduates, who have mastered the Bachelor's degree program are:

- processes and devices for enrichment and processing of mineral and technogenic raw materials with obtaining semi-products, production and processing of non-ferrous metals, as well as products made of them;

- processes and devices to ensure energy and resource conservation and environmental protection during technological operations;

– projects, materials, methods, instruments, installations, technical and regulatory documentation, quality management system, mathematical models;

– design and research divisions, production divisions.

Types and tasks of professional activity of a graduate

List of professional activities and corresponding professional tasks:

Types of professional activities	Professional tasks
research activities	- carrying out experimental research; - performing literature and patent searches, preparing technical reports, information reviews, publications; - study of scientific and technical information, domestic and foreign experience on the subject of research;
project analysis	- performing technical and economic analysis of the development of projects of new and reconstruction of existing shops, industrial units and equipment; - analyzing designs and calculations of technological equipment; - analyzing design and working technical documentation; - development and analysis of mathematical models;
production activities	- realization of technological processes of enrichment and processing of mineral natural and man-made raw materials; - implementation of technological processes of obtaining and processing of metals and alloys, as well as products made of them; - implementation of measures to protect the environment from technogenic impacts of production; - implementation of measures to ensure product quality; - organization of workplaces, their technical equipment, placement of technological equipment; - control over observance of technological discipline; - organization of maintenance of technological equipment;
design and technological activities	- collection of information for feasibility studies and participation in the development of projects for new and reconstruction of existing shops, industrial units and equipment;

	- calculation and design of elements of technological equipment; - development of design and working technical documentation;

2. Goal and objectives of the educational program

The purpose of EP 6B07219 - "Metallurgy of non-ferrous metals" is:

– training of competitive personnel with critical thinking, fundamental and applied knowledge, research skills in the field of non-ferrous metals metallurgy, capable of making comprehensive and effective decisions based on the principles of sustainable development in the processing of mineral raw materials from concentrates to metals and their compounds.

The objectives of EP 6B07219 - "Metallurgy of non-ferrous metals" are:

- Formation of skills and abilities to choose and evaluate methods of environmental protection from anthropogenic impact in urbanized areas;

– Strengthening the technological component of classical science education, to provide knowledge of modern technologies without lowering the bar of fundamental education;

- basics of development and carrying out fundamental and applied research in the field of non-ferrous metals metallurgy using new achievements of technologies, new generation techniques and ecomonitoring of enterprises;

- ensuring the interaction of fundamental and applied science with the educational process at all its stages, including the use of the results of joint research work in lecture courses, experimental base for the performance of educational and research, laboratory and course work, industrial and pre-graduation practice;

- ensuring training and retraining of personnel for the domestic mining and metallurgical sector in close cooperation with state corporations and the real sector of the economy, employment of graduates in knowledge-intensive innovative companies and other research centers.

- development of methods to reduce the environmental impact of metallurgical production, including the treatment of emissions and waste.

- development of skills in the field of resource conservation, energy efficiency and the introduction of closed production cycles.

3 Requirements for assessment of learning outcomes of the educational program

Because of mastering the educational program of Bachelor's degree 6B07219 - "Metallurgy of non-ferrous metals», the graduate should have general cultural, general professional and professional competences.

A graduate who has mastered the Bachelor's degree program shall possess the following competencies:

general cultural competencies:

- ability to use the basics of philosophical knowledge, analyze the main stages and patterns of historical development to realize the social significance of their activities;
- the ability to use the basics of economic knowledge in assessing the effectiveness of the results of activities in various spheres;
- ability to communicate orally and in writing in Russian and foreign languages to solve problems of interpersonal and intercultural interaction;
- ability to work in a team, tolerantly accepting social, ethnic, confessional and cultural differences;
- ability to self-organization and self-education;
- ability to use general legal knowledge in various spheres of activity;
- ability to maintain an adequate level of physical fitness to ensure full social and professional activity;
- readiness to use basic methods of protection of production personnel and population from possible consequences of accidents, catastrophes, natural disasters.

general professional competencies:

- readiness to use fundamental general engineering knowledge;
- readiness to critically analyze the accumulated experience, to change the profile of one's professional activity if necessary;
- ability to realize the social significance of his/her future profession;
- readiness to combine theory and practice to solve engineering problems;
- ability to apply in practice the principles of rational use of natural resources and environmental protection;
- ability to use normative legal documents in his/her professional activity;
- readiness to choose measuring instruments in accordance with the required accuracy and operating conditions;
- ability to follow metrological norms and rules, fulfill the requirements of national and international standards in the field of professional activity;
- ability to use the principles of quality management system.

professional competencies, corresponding to the type(s) of professional activity for which the Bachelor's program is oriented:

research activities:

- ability to analyze and synthesize;
- ability to choose research methods, plan and conduct necessary experiments, interpret results and draw conclusions;

- readiness to use physical and mathematical apparatus to solve problems arising in the course of professional activity;
- readiness to use basic concepts, laws and models of thermodynamics, chemical kinetics, heat and mass transfer;
- ability to choose and apply appropriate methods of modeling physical, chemical and technological processes.

project and analytical activities:

- ability to perform technical and economic analysis of projects;
- ability to use the process approach;
- ability to use information tools and technologies in solving problems arising in the course of professional activity;
- readiness to make calculations and draw conclusions when solving engineering problems.

production and technological activities:

- ability to implement and adjust technological processes in metallurgy and material processing;
- readiness to identify objects for improvement in engineering and technology;
- ability to select materials for products of various purposes, taking into account operational requirements and environmental protection;
- readiness to assess risks and determine measures to ensure safety of technological processes.

design and technology activities:

- ability to perform elements of projects;
- readiness to use standard software tools in designing;
- ability to justify the choice of equipment for the implementation of technological processes.

additional competencies in the field of organizational and management activities agreed with employers:

- ability to apply methods of technical and economic analysis;
- readiness to use the principles of production management and personnel management;
- readiness to use organizational and legal bases of managerial and entrepreneurial activity;
- ability to organize the work of the team to achieve the set goal.

additional general professional competencies (APCs) focused on knowledge areas: communication, individual and teamwork, lifelong learning, additional engineering skills:

- ability to acquire new, expand and deepen previously acquired knowledge, skills and competencies in various areas of life necessary for successful realization in the field of professional activity, including at the intersection of different areas of activity and fields of sciences.

Special requirements for graduation on this OP:

- the student should have a general idea of the thesis topic/research plans, and contact potential supervisors one year prior to expected graduation;

- a review meeting is held one year prior to expected graduation to introduce the student to potential supervisors and to expedite the student's selection of thesis/project topics;

- in order to collect the necessary data and study the actual tasks, methods and procedures on the topic of the thesis, the student undergoes an industrial practice;

- upon completion of the internship, the student shall contact the supervisor in writing or orally and report the results of the work, but not more than one week after the beginning of the 4th year of study;

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

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

4. Passport of the educational program

4.1. General information

№	Field name	Note
1	Code and classification of the field of education	6B07 - Engineering, manufacturing and construction industries
2	Code and classification of areas of study	6B072 - Manufacturing and processing industries
3	Group of educational programs	B071 - "Mining and extraction of minerals"
4	Name of the educational program	Metallurgy of non-ferrous metals
5	Brief description of the educational program	is aimed at preparing graduates to carry out research, production-technological, design-analytical and design-technological types of professional activities in various areas of metallurgy and includes analysis and implementation of technological processes, operation and design of equipment in various areas of metallurgical production.
6	Purpose of the OP	training of competitive personnel with critical thinking, fundamental and applied knowledge, research skills in the field of non-ferrous metals metallurgy, capable of making complex and effective decisions in the processing of mineral raw materials from concentrates to metals and their compounds.
7	Type of OP	New
8	NQF level	Level 6 - higher education and practical experience
9	ORC level	Level 6 - a wide range of specialized (theoretical and practical) knowledge (including innovative knowledge). Independent search, analysis and evaluation of professional information
10	Distinctive features of the EP	no
11	List of competencies of the educational program:	Professional Competencies; Research Competencies; Basic competencies and knowledge; Communicative competencies; General competencies; Cognitive competencies; Creative competences; Information and communication competencies.
12	Learning outcomes of the educational program:	LO1 - practicing knowledge of Kazakh, Russian and foreign languages to solve problems arising in the course of professional activity; LO2 - demonstrates knowledge of culture, basics of legal system and legislation of the Republic of Kazakhstan; LO3 - demonstrates fundamental knowledge and understanding of basic chemical laws in metallurgical processes; LO4 - implements and corrects technological processes in

		metallurgy of non-ferrous metals; LO5 - applies knowledge of physical and mathematical apparatus to solve production problems arising in technological processes of non-ferrous metals metallurgy; LO6 - performs professional function in the field of metallurgy, using methods of mathematical analysis and modeling, theoretical and experimental research; LO7 - applies in practice the principles of rational use of natural resources; the ability to develop and implement innovative technologies to reduce production emissions and rational use of raw materials. LO8 - justifies the choice of equipment for the implementation of technological processes; LO9 - applies applied software tools and modern methods of information processing in the sphere of professional activity; LO10 - applies experimental computational methods to solve various practice-oriented assignments of a research nature; LO11 - applies appropriate methods of modeling physical, chemical and technological processes in the field of metallurgy; LO12 - Demonstrates knowledge in the field of scientific and technological innovation, skills and abilities to search, evaluate, select information.
13	Form of training	Full-time full-time
14	Term of study	4 years
15	Loan volume	240
16	Languages of instruction	Kazakh/Russian
17	Academic degree awarded	Bachelor of Engineering and Technology
18	Developer(s) and authors:	Barmenshinova M.B. Dzhumankulova S.K.

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	Amount of credits	Formed learning outcomes (codes)											
				LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8	LO9	LO10	LO11	LO12
Cycle of general education disciplines Required component															
1	Foreign language	English is a compulsary subject. According to the results of placement test or IELTS score, students are placed into groups and disciplines. The name of the discipline corresponds to the level of English. When passing from level to level, prerequisites and postrequisites are respected.	10	V											
2	Kazakh (Russian) language	Kazakh (Russian) language In this course author considers socio-political, socio-cultural spheres of communication and functional styles of the modern kazakh (russian) language. The course covers the specifics of the scientific style to develop and activate professional communication skills and abilities of students. Also it allows students to leavn the basics of scientific style practically and develop the ability of production structural and semantic text analysis.	10	V											
3	Physical Culture	The purpose of the discipline is to master the forms and methods of forming a healthy lifestyle within the framework of the vocational education system. Familiarization with the natural-scientific foundations of physical education, possession of modern health technologies, basic methods of independent physical education and sports. And also as part of the course, the student will master the rules of judging in all sports.	8	V											
4	Information and Communication Technologies (in English)	The aim of the course is to gain theoretical knowledge in information processing, the latest information technologies, local and global networks, the methods of information protection; Getting the right use of text editor editors and tabulators; creation of base and different categories of applications.	5				V								
5	History of Kazakhstan	The purpose of the discipline is to provide objective historical knowledge about the main stages of the history of Kazakhstan from ancient times to the present day; to acquaint students with the problems of the formation and development	5		V										

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

		combating corruption as an antisocial phenomenon. Contents: improvement of socio-economic relations of the Kazakh society, psychological features of corrupt behavior, formation of an anti-corruption culture, legal responsibility for acts of corruption in various fields.														
10	Fundamentals of Economics and Entrepreneurship	Purpose: To develop basic knowledge of economic processes and skills in entrepreneurial activities. Content: The course aims to develop skills in analyzing economic concepts such as supply and demand, and market equilibrium. It includes the basics of creating and managing a business, developing business plans, risk assessment, and strategic decision-making.	5			V										
11	Fundamentals of research methods	The purpose of the discipline "Fundamentals of research methods" is the formation of students' skills and abilities in the field of methodology of scientific knowledge. Brief description of the discipline. Methodological foundations of scientific knowledge. The concept of scientific knowledge. Methods of theoretical and empirical research. Choice of the direction of scientific research. Stages of research work. Research topic and its relevance. Classification, types and tasks of the experiment. Metrological support of experimental studies. Computational experiment. Methods for processing the results of the experiment. Formulation of research results. Presentation of research work.	5			V										
12	Ecology and life safety	Purpose: formation of ecological knowledge and consciousness, obtaining theoretical and practical knowledge on modern methods of rational use of natural resources and environmental protection. Contents: the study of the tasks of ecology as a science, the laws of the functioning of natural systems and aspects of environmental safety in working conditions, environmental monitoring and management in the field of its safety, ways to solve environmental problems; life safety in the technosphere, emergencies of a natural and man-made nature.	5			V										
13	Basies of financial literacy	Purpose: formation of financial literacy of students on the basis of building a direct link between the acquired knowledge and their practical application. Contents: using in practice all kinds of tools in the field of financial management, saving and increasing savings, competent budget planning, obtaining practical skills in	5													

		calculating, paying taxes and correctly filling out tax reports, analyzing financial information, orienting in financial products to choose adequate investment strategies.														
Cycle of basic disciplines University component																
14	Mathematics I	Purpose: to introduce students to the fundamental concepts of linear algebra, analytical geometry and mathematical analysis. To form the ability to solve typical and applied problems of the discipline. Contents_ Elements of linear algebra, vector algebra and analytical geometry. Introduction to the analysis. Differential calculus of a function of one variable. The study of functions using derivatives. Functions of several variables. Partial derivatives. The extremum of a function of two variables.	5	V												
15	Mathematics II	Purpose: To teach students integration methods. To teach you how to choose the right method for finding the primitive. To teach how to apply a certain integral to solve practical problems. Contents_ integral calculus of the function of one and two variables, series theory. Indefinite integrals, methods of their calculation. Certain integrals and applications of certain integrals. Improper integrals. Theory of numerical and functional series, Taylor and Maclaurin series, application of series to approximate calculations_	5		V											
16	Physics	Purpose:To form ideas about the modern physical picture of the world and scientific worldview, the ability to use knowledge of fundamental laws, theories of classical and modern physics. Contents_ physical fundamentals of mechanics, fundamentals of molecular physics and thermodynamics, electricity and magnetism, vibrations and waves, optics and fundamentals of quantum physics.	5	V												
17	Engineering and computer graphics	Purpose: To develop students' knowledge of drawing construction and skills in developing graphical and textual design documentation in accordance with standards. Content: Students will study ESKD standards, graphic primitives, geometric constructions, methods and properties of orthogonal projection, Monge's projection, axonometric projections, metric tasks, types and features of connections, creating part sketches and assembly drawings, detailing, and creating complex 3D solid objects in AutoCAD.	5	V												
18	Chemistry	Purpose: formation of knowledge on fundamental issues of general chemistry and skills of their application in	5		V											

		professional activity. Summary Laws, theoretical propositions and conclusions that underlie chemical disciplines; properties and relationships of chemical elements based on the periodic law of D.I.Mendeleev and on modern ideas about the structure of matter; fundamentals of chemical thermodynamics and kinetics; processes in solutions; structure of complex compounds.													
19	Physical chemistry	Purpose: to form students' abilities to understand the physico-chemical essence of processes and to use the basic laws of physical chemistry in complex industrial and technological activities. Contents: laws of thermodynamics; basic equations of chemical thermodynamics; methods of thermodynamic description of chemical and phase equilibria in multicomponent systems; properties of solutions; fundamentals of electrochemistry; basic concepts, theories and laws of chemical kinetics and catalysis.	5				V								
20	Technological mineralogy	The purpose of studying the discipline is for students to study the basics of the theory of the formation of minerals in nature and their basic properties used in the production of various metals and basic raw materials of the Republic of Kazakhstan, as well as to instill skills in the active use of various types of literature. Contents: General information about the development of mineralogy and the structure of the earth. The formation of minerals and a brief description of rocks. Basic concepts of crystals. General properties of minerals and their classification. Silicates and carbonates. Oxides and hydroxides. Sulfides and sulfates. Tungsten and native metals. Halide compounds, phosphates and organic compounds. The concept of minerals and deposits. Properties of minerals used in ore dressing. Raw materials of the metallurgical industry and industrial classification of metals. Deposits of ferrous metal ores and alloys. Deposits of ores of non-ferrous and precious metals. Deposits of ores of rare, scattered, rare earth and radioactive metals.	4			V									
21	Basics of mineral deposits milling	Purpose: The purpose of teaching the discipline is for students to master the theory and practice of gravitational methods of enrichment of various types of mineral raw materials, to instill skills to analyze the operation of	6				V								

		gravitational devices and solve relevant applied problems. Contents: Classification of gravitational enrichment methods. Properties of minerals and media used in gravitational enrichment. The main patterns of movement of bodies in the environment. Theoretical foundations of gravitational enrichment processes. Hydraulic classification. Classification in the centrifugal field of forces. Enrichment of ores in heavy suspensions. Separators for the enrichment of ores in heavy suspensions. Separators for the enrichment of ores in heavy suspensions. Ore dressing by jigging. Jigging machines. Theoretical regularities of enrichment in a stream of water flowing along an inclined surface. Enrichment on concentration tables and screw separators. Enrichment in centrifugal concentrators. Washing of ores. Pneumatic enrichment.														
22	General metallurgy	Purpose: to form students' knowledge and skills in the field of metallurgy, to familiarize them with the main methods of metallurgical production, to teach them to analyze the conditions for the implementation of technological processes for the production of cast iron, steel, ferroalloys and non-ferrous metals Contents: Production of cast iron and iron, production of steel, production of non-ferrous metals: metallurgy of copper; metallurgy of nickel; metallurgy of aluminum; production of other non-ferrous metals.	5					V								
23	Theory of metallurgical processes I	Purpose: to form students' systematic knowledge about the main metallurgical processes of processing oxidized and sulfide mineral and man-made raw materials, salt melts. Contents: laws, theoretical provisions and conclusions on the structure and properties of metallic, oxide and sulfide systems: thermodynamics and kinetics of metallurgical processing of oxidized and sulfide mineral and man-made raw materials, salt melts; liquation and distillation processes of production; metal refining methods and the main directions of development of the theory and practice of extraction and refining of metals, taking into account the complex the use of raw materials and modern environmental requirements.	5					V								
24	Metallurgical Process Theory II	Purpose: to form a systematic understanding of the theoretical foundations and technology of modern hydrometallurgical methods of complex extraction of metals	5					V								

		from ore raw materials and metallurgical industrial products. Contents: Basic processes and operations in hydrometallurgy. Theoretical foundations and technological schemes of leaching processes. Thermodynamics and kinetics of leaching processes. Non-oxidative and oxidative leaching of metallurgical raw materials. Hydro- and electrometallurgical processing of sulfide materials. Theory and practice of extraction and sorption processes. Fundamentals of the deposition processes of poorly soluble compounds. Fundamentals of hydro- and electrometallurgical processes. Thermodynamics of electrochemical processes in the processing of metallurgical raw materials and the production of metals.														
25	Metallurgy of heavy non-ferrous metals	Purpose: To study the theoretical foundations of the extraction of heavy non-ferrous metals and technological schemes; to familiarize with the device and principles of operation of the devices used, operating parameters and process indicators, prospects for further development of technology Contents: Technological and theoretical foundations of metallurgical processes for the production of copper, nickel, lead and zinc. Properties of these metals and their compounds, preparation of raw materials for metallurgical processing. Pyrometallurgical and hydrometallurgical processing methods: roasting, melting, conversion, fire refining, leaching, purification of solutions, electrolysis and their hardware design. Methods of processing industrial products and new technologies to increase the complexity of the use of heavy non-ferrous metals in metallurgy.	5			V										
26	Metallurgy of precious metals	Purpose: To study the basic methods of obtaining precious metals. Contents: Properties and scope of noble metals and their compounds. Sources of raw materials and the history of mining of precious metals (gold and silver). Types of ores, minerals, enrichment and preparation of raw materials for metallurgical processing. Theoretical foundations and practice of the processes of opening (decomposition) of minerals of indigenous and placer ores and extraction of precious metals from them. Refining of precious metals. Hardware design of the main processes. Methods of associated extraction of precious metals from industrial	5					V								

		products and waste of metallurgical production. New technologies in the metallurgy of precious metals.													
27	Metallurgical heat engineering	The purpose of teaching the discipline is to acquire students ' knowledge in the field of heat engineering processes, as well as the theory of metallurgical furnaces, familiarization with the designs of furnaces, heat exchangers and heat generators, the ability to calculate fuel Gorenje, heat transfer characteristics, make thermal balances of metallurgical furnaces. Contents: Technical thermodynamics. Introduction to metallurgical heat engineering. Heat generation due to the chemical energy of fuel and electricity. The main provisions of the theory of heat transfer. Heat transfer by thermal conduivity. Heat transfer by convection. Heat exchange by radiation. Mechanics of liquids and gases. Fundamentals of similarity theory and modeling. Fundamentals of the general theory of furnaces. Thermal operation and designs of roasting and drying furnaces. Melting and casting furnaces. Refractory materials. Energy equipment. The use of secondary energy resources.	5			V									
28	Metallurgical Engineering (in English)	Purpose: Studying the theory of metallurgical processes, the main methods of enrichment of mineral raw materials, on the classification of metals and metallurgical processes and technologies, on methods of obtaining ferrous and non-ferrous metals, when students perform a critical analysis of domestic and foreign, world literature of metallurgical profile in English. Content: Composition and properties of the gas phase. Thermodynamics of metallurgical processes. Theory of dissociation and strength of chemical compounds. Structure and properties of oxide and metallic melts. Fundamentals of interaction of metallic and oxide phases. Kinetics of processes. Preparation of raw materials for metallurgical process. Classification of metals. Metallurgy of ferrous metals. Production of pig iron and steel. Metallurgy of non-ferrous metals. Hydrometallurgy. Pyrometallurgy. Metallurgical calculations.	5					V							
29	Metallurgy of light metals	Purpose: To study the basic technologies of light metals production. Content: Metallurgy of aluminum. Production volumes and applications. Properties of aluminum. Raw material base of	5												

		alumina and aluminum production. Production of alumina. Aluminum production. Magnesium production. Production volumes and applications. Properties of magnesium and its compounds. Raw materials and their preparation. Theoretical bases of electrolytic production of magnesium. Titanium production. Production volumes and spheres of application. Properties of titanium and its compounds. Deposits and ores of titanium. Processing of ore raw materials. Smelting of titanium slags. Production of titanium tetrachloride. Metallothermic production of titanium. Titanium alloys.													
30	Organization and planning of experiment	Objectives of the study: To form students' knowledge and skills of qualitative planning and conducting metallurgical experiments, modern scientific research. Summary: The following sections are considered in the discipline: methodological foundations of scientific knowledge and creativity; organization and conduct of experimental research. Methods of theoretical and empirical research. Processing and analysis of data, their registration in the report. The technique of working with literature. Laboratory experiment technique. Familiarization with the processes and devices for conducting experimental work. Testing the reproducibility of experiments. Methods of processing experimental results. Fundamentals and methods of experiment planning. Planning of a first-order experiment and full, fractional factorial experiments. Optimization. Gradient method of experiment planning. The essence of the simplex planning method.	4												
31	Heat engineering of metallurgical processes	Purpose: to teach students the methods of obtaining and converting heat, as well as the principles of operation and design features of thermal units. Contents: Basic concepts and definitions of the working fluid and its basic parameters, analysis of the fundamental laws of thermodynamics, thermodynamic processes, differential equations of thermodynamics, outflow and throttling of gases and vapors. The mutual conversion of heat into work, the relationship between thermal, mechanical and chemical processes that occur in thermal and cooling mechanisms. Heat generation due to the chemical energy of fuel and electricity. The main provisions of the theory of heat transfer..	5						V						

Cycle of basic disciplines Component of choice															
32	Fundamentals of complex processing of polymetallic raw materials	The purpose of studying the discipline "Technologies of mineral enrichment" is to form students' knowledge bases, develop professional skills and primary skills in the field of mineral enrichment technology. Content: Non-ferrous metallurgy of the Republic of Kazakhstan is distinguished by the variety of raw materials used, complex technological schemes, large volumes of man-made materials obtained, which must be efficiently processed with the extraction of valuable components. Complex processing of polymetallic raw materials for the production of heavy non-ferrous metals. Complex processing of polymetallic raw materials for the production of light metals. Complex processing of polymetallic raw materials for the production of rare metals. Non–ferrous metal ores are raw materials for the production of small metals and scattered elements. The effectiveness of the integrated use of raw materials at non-ferrous metallurgy enterprises.	5				V								
33	Geotechnologies in metallurgy	Purpose: Study of geotechnological methods of processing of complex metallurgical raw materials. Content: Geochemical processes in the Earth's crust. Formation of minerals and deposits of non-ferrous and ferrous metals. Methods of geotechnology. Possibilities of metal extraction by geotechnological methods. Selection of the method of geotechnological extraction of metals in accordance with the nature and condition of ore reserves. Underground, borehole and group leaching. Influence of the nature of the reagent on metal recovery.	5				V								
34	Fundamentals of sustainable development and ESG projects in Kazakhstan	Purpose: the goal is for students to master the theoretical foundations and practical skills in the field of sustainable development and ESG, as well as to develop an understanding of the role of these aspects in the modern economic and social development of Kazakhstan. Contents: introduces the principles of sustainable development and the implementation of ESG practices in Kazakhstan, includes the study of national and international standards, analysis of successful ESG projects and strategies for their implementation in enterprises and organizations.	5												
35	Special electrometallurgy	Purpose: to form students' knowledge in the field of theoretical and applied electrochemistry aimed at obtaining	5					V							

		and refining non-ferrous metals. Contents: The history of development and the main provisions of theoretical and applied electrochemistry. The essence of the operation of a galvanic cell and an electrolysis bath. Faraday's laws. Coulometers. Electrode potentials. The EMF of the galvanic cell. Classification of electrodes. Electrocapillary and electrokinetic phenomena. Electrochemical and diffusion kinetics. The joint discharge of ions. Electrocrystallization of metals at the cathode. Kinetics of anodic dissolution of metals. Physico-chemical bases of electrolysis of aqueous solutions and molten media. Electroplating coatings using rare metals. Electrofining and electrodeposition of copper from aqueous solutions of copper sulfate. Electrolysis of nickel. Electroextraction of zinc and lead. Electrolytic production of aluminum from cryolytic alumina melt. Electrolytic production of magnesium and sodium. Electrolysis of refractory rare metals. Electrolysis of gold and silver. Prospects for the application of electrolysis in modern metallurgy													
36	Technology of composite materials	Aim of study : acquisition by the students of knowledge in the areas of receipt of composition materials, acquaintance with classification, methods of determination and properties of composition materials. Short maintenance: Determination and classification of composition materials. Basic concepts of mechanics of composition materials : module of resiliency, durability, destruction, chemical, thermal and mechanical stability. Components used for the production of composition materials : matrix and reinforcing materials and their receipt.	5					V							
37	Legal regulation of interlineal property	Purpose: the goal is to form a holistic understanding of the system of legal regulation of intellectual property, including basic principles, mechanisms for protecting intellectual property rights and features of their implementation. Content: The discipline covers the basics of IP law, including copyright, patents, trademarks, and industrial designs. Students learn how to protect and manage intellectual property rights, and consider legal disputes and methods for resolving them.	5						V						
38	Autogenous processes in metallurgy	Purpose: Study of autogenous processes of raw materials processing. Content: Issues of theory and practice of modern autogenous	5						V						

		processes of processing of non-ferrous metals raw materials (KIVCET, PZHV, Outokumpu-Ou, QSL, Ausmelt, Isasmelt, etc.). Process chemistry, peculiarities of sulfide oxidation, process indicators, characterization of smelting products. Technological schemes of productions, design and principle of operation of metallurgical units, basic technical and economic indicators of processes.													
39	Powder metallurgy	Purpose: the student acquires knowledge in the field of production of powder materials, familiarization with their basic properties and methods of production. Contents: classification of methods for obtaining powder materials. Mechanical methods for obtaining powder materials. Reducers used in powder metallurgy. Preparation of powders by methods of reduction of chemical compounds of metals. Examples of obtaining powdered metals by methods of high-temperature reduction of chemical compounds. Obtaining powder reduction materials from solutions.	5						V						
40	Fundamentals of Artificial Intelligence	Purpose: to familiarize students with the basic concepts, methods and technologies in the field of artificial intelligence: machine learning, computer vision, natural language processing, etc. Contents: general definition of artificial intelligence, intelligent agents, information retrieval and state space exploration, logical agents, architecture of artificial intelligence systems, expert systems, observational learning, statistical learning methods, probabilistic processing of linguistic information, semantic models, natural language processing systems.	5												
41	Dust collection and gas cleaning in non-ferrous metallurgy	Purpose: to form students' knowledge of theoretical principles of operation, design features and operational performance of apparatuses and schemes of plants for dust collection and chemical purification of gases. Content: The course "Dust collection and gas purification in non-ferrous metallurgy" considers the processes occurring in various gas cleaning devices, the design of dust collectors, conditions and features of their operation, as well as methods of their calculation. The schemes used for purification of gases from dust and harmful gaseous components in various shops of ferrous and non-ferrous metallurgy enterprises are studied.	6						V						

42	Metallurgical furnaces	Purpose: the formation of students systematized knowledge of the main types of fuel and its combustion, classification and general characteristics of the operation of furnaces, materials used in furnace construction, the course program provided for the study of elements and designs of a number of furnaces used in non-ferrous and ferrous metallurgy. Content: Classification of furnaces and modes of operation. Thermal characteristics of furnace operation. Thermal balance and fuel consumption. Refractory and insulating materials, building elements of furnaces. Thermal insulation materials. Furnace construction elements and materials. Utilization of secondary energy resources. Thermotechnical bases of various methods of waste gas heat utilization. Metallurgical furnaces. Fuel furnaces of ferrous metallurgy. Fuel furnaces of non-ferrous metallurgy. Furnaces of ferrous metallurgy with heat generation by burning out metal impurities. Nonferrous metallurgy furnaces with full or partial use of chemical energy of raw materials. Thermal and temperature modes of operation of the furnace for roasting sulfide concentrates in a fluidized bed. Thermal and temperature modes of operation of furnaces for smelting for matte (autogenous processes). Electric furnaces. Special furnaces. Furnaces for titanium production.	6						V						
Cycle of specialized disciplines University component															
43	Metallurgy of rare and disseminated metals	Purpose: The field of technological methods for obtaining rare and diffuse elements from ore and anthropogenic raw materials due to their chemical properties. Content: The concept of "rare metals", the technical classification of these metals. The position of rare earth metals in the periodic table of elements of Mendeleev and the features of the technology of obtaining rare metals. Physical and chemical properties, applications, sources of raw materials of rare metals. The main processes of processing raw materials containing rare metals, with the production of finished products in the form of chemical compounds or pure metals. Physico-chemical bases and technology of production of scattered rare metals (rhenium, selenium, tellurium, germanium, gallium, indium, thallium), the characteristics of physical and chemical properties, areas of application of these metals are given. The methods of production of	4							V					

		chemical compounds of dispersed metals from ore and secondary raw materials, the use of liquid extraction and ion exchange resins in the schemes of processing solutions, the issues of complex use of raw materials are considered. The methods of metal recovery from various compounds and the production of compact metals by melting and powder metallurgy methods are highlighted and compared.													
44	Non-ferrous metals alloys	The purpose of the study of the discipline is to study the basic provisions for obtaining alloys of non-ferrous metals: aluminum, magnesium, beryllium, titanium, copper, nickel, chromium, manganese, vanadium refractory metals, rare earth and radioactive metals and alloys based on them. Content: the main processes of smelting alloys of non-ferrous metals cover problems of a theoretical, technological and constructive nature in the field of traditional and new processes of metallurgy. Acquisition of competencies for the analysis of technologies for the production of metals, the development of technological schemes and designs of metallurgical units and the implementation of technological calculations.	5							V						
45	Metallurgy of secondary raw materials	Purpose: Study of the basic processes in hydrometallurgy. Theoretical foundations and technological schemes of leaching processes. Content: Modern methods of processing of secondary raw materials. New processes of additional extraction of non-ferrous and valuable metals from secondary raw materials. Characteristics of secondary raw materials, features of the structure, forms of non-ferrous and valuable metals. Selection and justification of methods of processing of secondary raw materials, economic analysis and evaluation of their possible processing. Waste-free, environmentally friendly technologies for processing of secondary raw materials with complex extraction of valuable metals.	5							V						
46	Modern ecological schemes and forecasting in metallurgy	Purpose: Formation of knowledge in the field related to the creation of environmentally friendly metallurgical production, existing low-waste and environmentally friendly technologies of production of ferrous and non-ferrous metals. Content: The main factors of impact of metallurgy on the environment. Consumption of primary and secondary resources. Saving of materials and energy. General principles of creation of ecologically clean metallurgy and requirements	6						V							

		to it. Formation of ecological strategy at full cycle plants. Classification of man-made resources. Payment for environmental pollution. Assessment of ecological damage. Ecological and economic efficiency. Main tasks, objects, methods and classification of environmental monitoring system. Environmental management system. Environmental certification. Basic provisions of the series of standards and certification for compliance with ISO 14000 standards.													
Cycle of specialized disciplines Component of choice																
47	Processes and devices in non-ferrous metallurgy	The aim is to provide students with the basic knowledge and skills necessary to solve theoretical and practical problems of hydromechanical, thermal, mass-exchange processes and powder metallurgy, allowing to justify the choice of technological process. Content: Physico-chemical basis and technology of non-ferrous metals production from ore and secondary raw materials. Characteristics of starting materials, methods of charge preparation, pyro- and hydrometallurgical processing. Equipment, technical and economic indicators of modern metallurgical processes. Integrated use of raw materials, environmental protection, prospects for the development of metallurgy.	5						V						
48	Theory and practice of metal refining	The purpose of the study: the acquisition by students of knowledge in the field of physico-chemical bases of the most significant methods of separation and purification of metals and their practical application. Summary: Methods for separation, concentration and purification of metals (extraction, ion exchange, electrolysis and electrodialysis, crystallization from solutions and melts, purification and separation of metals using vacuum and gas-phase metallurgy methods, etc.), instrumentation of processes, engineering calculation Methods of cleaning metals.	5						V						
49	Processes of processing of technogenic waste	Purpose: To study the processes of processing of anthropogenic wastes Content: The course "Processes of processing of anthropogenic waste" considers the main ways of processing of anthropogenic raw materials of some heavy non-ferrous, noble, light and rare metals. In particular, the main sources of waste generation, their classification and characterization are	4						V						

		considered. Modern schemes are given, the design of the main and auxiliary equipment for the preparation of waste for metallurgical processing is described. Modern pyro- and hydrometallurgical methods of processing anthropogenic wastes, basic technological schemes and hardware design of the processes of production of basic heavy, rare, light and noble metals from lump wastes, slags, dusts, sludge, industrial solutions and a number of other anthropogenic wastes are covered.													
50	Corrosion and protection of metals	The purpose of the study: to give students knowledge about the interaction of metals with the environment around them, about the mechanism of this interaction; to teach the use of physico-chemical patterns to predict the corrosion resistance of metals, to apply appropriate protection methods. Contents: Classification of corrosion processes. Films on metals. The mechanism of diffusion in protective films. Electrochemical corrosion. Thermodynamics of electrochemical corrosion. Secondary processes and electrochemical products. Classification of protection methods. Methods of protection against chemical and electrochemical corrosion.	4						V						
51	Copper and nickel metallurgy	Purpose: Study of theoretical bases and technologies of copper and nickel production by traditional and modern methods. Content: Technological schemes and processes of processing raw materials containing copper, nickel and other related valuable components; theoretical foundations of technological processes of metal production; designs of metallurgical units and principles of their operation, operating parameters and indicators.	6							V					
52	Production of special alloys	Purpose: Formation of knowledge about the properties of special-purpose alloys; about the main methods of production of special alloys; about the physical basis and use of methods of obtaining alloys and materials with specified properties. Content: Classification of special alloys and the structure of alloys of the type of mechanical mixtures, type of chemical compounds and type of solid solutions. The course also studies the basics of theory and technology of production of various high-temperature alloys and their properties. Methods of direct synthesis and reduction, vapor deposition and electrolysis, plasma and mechanical alloying are considered.	6							V					

		The structure and state diagrams of special-purpose alloys are considered. The necessary information on iron-carbon, titanium and copper, aluminum and magnesium, zinc, hard and magnetic, heat-resistant and heat-resistant alloys, as well as special steels and their applications are given.													
53	Metallurgy of lead and zinc	Purpose: to form students' knowledge about the technological features of lead and zinc metallurgy; modern production processes of these metals, ensuring the integrated use of raw materials, environmental protection, resource, energy conservation and waste disposal. Contents: Technological schemes and physico-chemical bases of the processes of obtaining lead and zinc from ores, concentrates and industrial products. Modern pyro- and hydrometallurgical methods for the production of lead and zinc, the main technological schemes and hardware design of the production processes of these metals. The processes of preparing raw materials for metallurgical conversion, the processes of reducing melting in mine furnaces, the processes of roasting, leaching, purification of solutions from impurities, fire refining, electrolytic refining in aqueous media to produce commercial lead and zinc. New technologies in the production of lead and zinc.	5								V				
54	Modern principles of resource and energy saving in metallurgy rare metals	Purpose: Studying the principles of resource and energy saving in metallurgy of rare metals Content: Basics of modern principles of resource and energy saving in metallurgy of rare metals: lithium, beryllium, gallium; rare refractory metals: vanadium, titanium, molybdenum, tungsten. Fundamentals of resource-saving complex processing of rare and refractory rare metals. Integrated processing of raw materials and waste production of rare and refractory rare metals. Principles of energy saving. Selection of technological schemes that allow for the integrated use of natural raw materials of rare, refractory rare metals, taking into account environmental requirements.	5								V				
55	Fundamentals of metallurgical production design	Purpose: to form students' knowledge in the field of scientific principles of the organization of technological design and construction of metallurgical facilities, taking into account the requirements of modern regulatory documents, current instructions regulating a high level of standardization and unification of standard projects and new design solutions for the organization of planning and development of the territory	5									V			

		of an industrial area in the structure of the city, the territory of a metallurgical facility, industrial buildings and building structures. Contents: General information about the design. The design stages of industrial facilities. Pre-project documentation. The composition of the design and estimate documentation. The initial data for the design. Technological design of metallurgical facilities. Selection and justification of the hardware and technological scheme for the production of commercial metals or its compounds in metallurgical plants. Selection and calculation of equipment for metallurgical plants. Introduction to the architectural and construction design of industrial facilities. The placement of enterprises in the structure of the city, their classification, grouping and formation of industrial areas and nodes. Spatial planning formation of the building of the factory territory. Building methods. Types of construction objects. Entrances and entrances to industrial facilities. Construction of the pre-factory territory. Highways and driveways. Gaps between buildings and structures. Design of industrial buildings. The main structural elements of industrial buildings. Transportation of metallurgical facilities. Engineering networks and communications of metallurgical facilities. Landscaping, elements of monumental and decorative art and visual information in industrial enterprises.													
56	Technology of refractory and heat-insulating materials	Purpose: to form knowledge in the field of refractory, thermal insulation and building materials, their properties and applications. Contents: Classification of refractory materials. Raw materials for production. Refractory products. Schematic diagram of the production and structure of refractories. The structure of refractories. Working properties of refractory materials: fire resistance, gas permeability, dimensional stability, heat resistance, chemical resistance and slag resistance. Physical properties of refractories: thermal expansion coefficient, heat capacity, thermal conductivity, electrical conductivity. Characteristics of some refractory materials (silica, aluminosilicate, chamotte, high alumina, magnesia-based and others). Thermal insulation materials, natural and artificial, their characteristics and the requirements imposed on them. Classification and properties	5									V			

		of building materials: brick, concrete, crushed stone, sand, varnishes, paints.													
57	Recycling technologies in heavy non-ferrous metals metallurgy	Purpose: Studying the technology of heavy non-ferrous metals recycling, methods of waste processing for the purpose of reuse of the obtained raw materials. Content: Secondary raw materials of heavy non-ferrous metals. Preparation of secondary raw materials of heavy non-ferrous metals for metallurgical processing. Basics and methods of pyro- and hydrometallurgical processing of secondary raw materials of heavy non-ferrous metals. Apparatus design of obtaining secondary heavy non-ferrous metals. Technology of processing waste and secondary raw materials of lead, copper, zinc, nickel. Auxiliary processes in the production of secondary heavy non-ferrous metals. Ecological and economic aspects of production of secondary heavy non-ferrous metals.	5										V		
58	Advanced metallurgy and product design	Purpose: formation of systematized knowledge, skills and abilities in the field of metallurgical processing, advanced metallurgy and design of metallurgical products, final metallurgical products. Content: Processes and technologies of the 2nd stage – refining of rough metals, production of steel and alloys, methods of processing scrap metal. Processes and technologies of the 3rd stage – metal processing by pressure in order to obtain metal products of a given design. Processes and technologies of the 4th stage – additional processing of rolled products. Manufacture of hardware. Recycling of diesel slags, as well as modern design methods using 3D modeling of products.	5										V		
59	Metallurgy of small metals (Cd, Co, Bi, etc.)	Purpose: to prepare bachelors who are competent in the theory and practice of metallurgical processes for the extraction of small non-ferrous metals; to familiarize themselves with modern production, the device and principles of operation of the main units, operating parameters and process indicators. Contents: Bismuth metallurgy, properties and applications. Extraction of bismuth from intermediate products of metallurgical production. Processing of bismuth ores and concentrates. Processing of complex concentrates containing bismuth. Purification (refining) of rough bismuth. Metallurgy of cadmium, properties and applications. Hydrometallurgical	4											V	

		method for the production of cadmium. A mixed method for producing cadmium. Remelting and purification of rough cadmium. Metallurgy of cobalt, properties and applications. Production of cobalt from cobalt-containing copper concentrates. Extraction of cobalt from pyrite concentrates. Processing of cobalt concentrates from nickel electrolysis plants. Tin metallurgy, properties and applications. Smelting of tin from concentrates, refining of tin.													
60	New technologies in metallurgy	Purpose: to develop professional competencies in the correct understanding of the basics of new metallurgical technologies, to get acquainted with new technologies in metallurgy. Contents: Chloride and autoclave methods of lead extraction. Autoclave treatment of low grade zinc concentrates. The latest technologies for the production of aluminum and its alloys. New metallothermal and electrochemical processes of titanium production. Technology of bioassay of copper-containing raw materials, Solvent Extraction electrowinning (SX/EW). Extraction and sorption methods for the production of metals. Perplexing methods of ferrous metal production.	4												V	
61	Modeling of metallurgical processes	Objective: to study the methodology based on economic and mathematical modeling and used in decision support systems. Contents: Introduction to modeling. General information about mathematical modeling. Modeling of deterministic processes. Stochastic models. Processing of initial results by interpolation and statistical methods (Newton's method). The concept of numerical methods for solving algebraic and differential equations. Numerical methods of unconditional optimization. Classification of conditional optimization problems. Linear programming. Problems of discrete optimization and dynamic programming. Definition of mathematical models.	5													V
62	Metallurgical systems research	Purpose: to develop students' theoretical knowledge and practical skills in the field of metallurgical processes and systems research. Contents: Current state and development of physico-chemical methods for the study of metallurgical systems and processes; methods for measuring temperatures, viscosity, density, electrical conductivity and surface tension of melts, measuring vapor pressure of metals and their compounds,	5													V

		methods for quality control of metal products; fundamentals of thermodynamic and kinetic analysis of pyrometallurgical and hydrometallurgical processes													

5. Curriculum of the educational program

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

SATBAYEV UNIVERSITY

APPROVED
Chairman of the Management Board-
Rector of KazNRTU named after K.Satbayev
M.M. Begentaev
«25» 04 2024 y.

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

Educational program 6B07219 - "Metallurgy of non-ferrous metals"
Group of educational programs B171 - "Metallurgy"

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

Discipline code	Name of disciplines	Cycle	Total amount in academic credits	Total hours	classroom volume of lek/lab/pr	SIS (including TSIS) in hours	Form of control	Allocation of face-to-face training based on courses and semesters							
								I course		II course		III course		IV course	
								1 semester	2 semester	3 semester	4 semester	5 semester	6 semester	7 semester	8 semester
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)															
M-1. Module of language training															
LNG108	English language	GED, RC	5	150	0/0/3	105	E	5							
LNG108	English language	GED, RC	5	150	0/0/3	105	E		5						
LNG104	Kazakh (Russian) language	GED, RC	5	150	0/0/3	105	E	5							
LNG104	Kazakh (Russian) language	GED, RC	5	150	0/0/3	105			5						
M-2. Module of physical training															
KFK101-104	Physical Culture	GED, RC	8	240	0/0/8	120	Difcredit	2	2	2	2				
M-3. Module of information technology															
CSE677	Information and communication technologies (in English)	GED, RC	5	150	2/1/0	105	E				5				
M-4. Module of socio-cultural development															
HUM137	History of Kazakhstan	GED, RC	5	150	1/0/2	105	SE		5						
HUM132	Philosophy	GED, RC	5	150	1/0/2	105	E				5				
HUM120	Socio-political knowledge module (sociology, politology)	GED, RC	3	90	1/0/1	60	E				3				
HUM134	Socio-political knowledge module (culturology, psychology)		5	150	2/0/1	105	E			5					
M-5. Module of anti-corruption culture, ecology and life safety base															
HUM136	The base of anti-corruption culture and law	GED, CCH	5	150	2/0/1	105	E			5					
MNG489	Fundamentals of economics and entrepreneurship														
HPP128	Fundamentals of research methods														
CHE656	Ecology and life safety														
MNG564	Basics of Financial Literacy														
CYCLE OF BASIC DISCIPLINES (BD)															
M-6. Module of physical and mathematical training															
MAT101	Mathematics I	BD, UC	5	150	1/0/2	105	E	5							
PHY468	Physics	BD, UC	5	150	1/1/1	105	E	5							
MAT102	Mathematics II	BD, UC	5	150	1/0/2	105	E		5						
M-7. Module of basic training															
GEN429	Engineering and computer graphics	BD, UC	5	150	1/0/2	105	E	5							
CHE495	Chemistry	BD, UC	5	150	1/1/1	105	E		5						
CHE127	Physical chemistry	BD, UC	5	150	1/1/1	105	E				5				
MET514	Fundamentals of complex processing of polymetallic raw materials	BD, CCH	5	150	2/0/1	105	E								
MET657	Geotechnology in metallurgy				2/0/1							5			
MNG563	Fundamentals of sustainable development and ESG projects in Kazakhstan				2/0/1										
MET518	Special electrometallurgy	BD, CCH	5	150	2/0/1	105	E								
MET611	Technoladgy of composite materials				2/0/1								5		
MNG562	Legal regulation of intellectual property				2/0/1										

MET652	Autogenous processes in metallurgy	BD, CCH	5	150	2/0/1	105	E						5		
MET599	Powder metallurgy				2/0/1										
CSE831	Fundamentals of Artificial Intelligence				1/0/2										
MET653	Dust collection and gas cleaning in non-ferrous metallurgy	BD, CCH	6	180	2/0/2	120	E							6	
MET612	Metallurgical furnaces				2/0/2										
AAP173	Educational practice	BD, UC	2		0/0/2				2						
M-8. Basic training module in metallurgy															
MET501	Technological mineralogy	BD, UC	4	120	2/1/0	75	E	4							
MET163	Basics of mineral deposits milling	BD, UC	6	180	2/1/1	120	E			6					
MET500	General metallurgy	BD, UC	5	150	2/0/1	105	E			5					
MET619	Theory of metallurgical processes I	BD, UC	5	150	2/1/0	105	E			5					
MET503	Metallurgy of heavy non-ferrous metals	BD, UC	5	150	2/1/0	105	E				5				
MET596	Theory of metallurgical processes II	BD, UC	5	150	2/1/0	105	E				5				
MET510	Metallurgy of precious metals	BD, UC	5	150	2/0/1	105	E					5			
MET620	Metallurgical heat engineering	BD, UC	5	150	2/1/0	105	E					5			
MET621	Metallurgical engineering (in English)	BD, UC	5	150	2/0/1	105	E					5			
MET654	Metallurgy of light metals	BD, UC	5	150	2/1/0	105	E					5			
MET658	Organization and planning of experiment	BD, UC	4	120	2/0/1	75	E					4			
MET622	Heat engineering of metallurgical processes	BD, UC	5	150	2/0/1	105	E						5		
CYCLE OF PROFILE DISCIPLINES (PD)															
M-9. Module of professional activity in metallurgy															
MET655	Metallurgy of rare and dispersed metals	PD, UC	4	120	2/0/1	75	E						4		
MET656	Non-ferrous metal alloys	PD, UC	5	150	2/0/1	105	E							5	
MET508	Metallurgy of secondary raw materials	PD, UC	5	150	2/1/0	105	E							5	
MET498	Modern ecological schemes and forecasting in metallurgy	PD, UC	6	180	2/0/2	120	E							6	
M-10. Professional activity module															
MET524	Processes and devices in non-ferrous metallurgy	PD, CCH	5	150	2/0/1	105	E						5		
MET497	Theory and practice of metal refining				2/1/0										
MET456	Processes of processing of technogenic waste	PD, CCH	4	120	2/0/1	75	E						4		
MET659	Corrosion and protection of metals				2/1/0										
MET194	Copper and nickel metallurgy	PD, CCH	6	180	2/1/1	120	E							6	
MET422	Production of special alloys				2/0/2										
MET529	Metallurgy of lead and zinc	PD, CCH	5	150	2/1/0	105	E							5	
MET692	Modern principles of resource and energy saving in metallurgy of rare metals				2/0/1										
MET575	Fundamentals of metallurgical production design	PD, CCH	5	150	2/0/1	105	E								5
MET594	Technology of refractory and heat-insulating materials				2/0/1										
MET545	Recycling technologies in heavy non-ferrous metals metallurgy	PD, CCH	5	150	2/1/0	105	E								5
MET582	Advanced metallurgy and product design				2/0/1										
MET455	Metallurgy of small metals (Cd, Co, Bi, etc.)	PD, CCH	4	120	2/0/1	75	E								4
MET697	New technologies in metallurgy				2/0/1										
AAP180	Production practice I	BD, UC	2		0/0/2						2				
AAP183	Production practice II	PD, UC	3		0/0/3								3		
M-11. Module of "R&D"															
MET558	Modelling of metallurgical processes	PD, CCH	5	150	2/0/1	105	E								5
MET583	Metallurgical systems research				2/1/0										

M-12. Module of final attestation															
ECA109	Writing and defense of the thesis / project	FA	8												8
M-13. Module of additional types of training															
AAP500	Military affairs	ATT	0												
Total based on UNIVERSITY:								31	29	28	32	29	31	33	27
								60		60		60		60	

Number of credits for the entire period of study					
Cycle code	Cycles of disciplines	Credits			
		required component (RC)	university component (UC)	component of choice (CCH)	Total
GED	Cycle of general educatico disciplines	51		5	56
BD	Cycle of basic disciplines		89	21	176
PD	Cycle of profile disciplines		27	39	
	Total for theoretical training:	*51*	*116*	*65*	*232*
FA	Final attestation	8			8
	TOTAL:	59	116	65	240

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

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

Decision of the Academic Council of MaMI named after O. Baikonurov. Protocol № 7, 29.03.2024

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

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