SATBAYEV UNIVERSITY

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

EDUCATIONAL PROGRAM

6B07203 - Metallurgy and mineral processing

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, 2022

The educational program "6B07203 - Metallurgy and mineral processing" was approved at a meeting of the Academic Council of KazNTU named after. K.I. Satpaeva.

Protocol No. 13 dated "28" 04 2022

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

Protocol No. 7 dated "26" 04 2022.

The educational program "6B07203 - Metallurgy and mineral processing" was developed by the academic committee in the direction "Production and manufacturing industries"

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

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List of abbreviations and symbols

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

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

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

EP - educational program;

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

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

WC - working curriculum;

CED - catalog of elective disciplines;

UC - university component;

CC - component of choice;

NQF - National Qualifications Framework;

SQF - Sectoral Qualifications Framework;

LO - learning outcomes;

KC - key competencies.

1. Description of the educational program

It is intended for the implementation of profile training of bachelors in the educational program "6B07203 - Metallurgy and mineral processing" at Satbayev University and was developed as part of the direction "Industrial and manufacturing 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;

– Law of the Republic of Kazakhstan “On amendments and additions to certain legislative acts of the Republic of Kazakhstan on the issues of expanding the academic and managerial independence of higher educational institutions” dated 04.07.18 No. 171-VI;

- Order of the Minister of Education and Science of the Republic of Kazakhstan dated October 30, 2018 No. 595 “On Approval of the Model Rules for the Activities of Educational Organizations of the Relevant Types”;

- State obligatory standard of higher education (Appendix 7 to the order of the Minister of Education and Science of the Republic of Kazakhstan dated October 31, 2018 No. 604;

– Decree of the Government of the Republic of Kazakhstan dated 19.01.12 No. 111 “On approval of the Model Rules for Admission to Education in Educational Organizations Implementing Educational Programs of Higher Education” with amendments and additions dated 07.14.16 No. 405;

– Decree 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”;

– Decree of the Government of the Republic of Kazakhstan dated December 31, 2019 No. 1050 “On Approval of the State Program for Industrial and Innovative Development of the Republic of Kazakhstan for 2020-2025”;

– “National Qualifications Framework”, approved by the protocol dated June 16, 2016, by the Republican Tripartite Commission on Social Partnership and Regulation of Social and Labor Relations;

– Sectoral qualifications framework "Mining and metallurgical complex" dated July 30, 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, December 14, 2012;

– “New opportunities for development in the conditions of the fourth industrial revolution”. Message of the President of the Republic of Kazakhstan N. Nazarbayev to the people of Kazakhstan. 01/10/2018;

– “The Third Modernization of Kazakhstan: Global Competitiveness”. Message of the President of the Republic of Kazakhstan N.Nazarbayev to the people of Kazakhstan. 01/31/2017

Introduction to the educational program. The development of an innovative economy initially forms the so-called double helixes of interaction - between universities (science) and business, business and government, etc., which then form a "triple helix". The triple helix model generates interdisciplinary knowledge generated by interdisciplinary teams brought together for a short time to work on a specific real-world problem. In the triple helix model, universities, along with the educational and research function, further increase entrepreneurial functions, actively participating in the cultivation of start-ups together with industry, stimulated by the state.

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

Figure 1 - The concept of scientific and educational programs

The previously established structure of education, based on the deep training of specialists in a narrowly focused specialization, has led to the emergence of interdisciplinary barriers and curbing the development of new "growth points" that are at the intersection of disciplines.

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

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

The program is complex and science intensive. The efficiency of using its results is of strategic importance for the republic.

The program is aimed at training specialists in key areas of the mining and metallurgical industry, adapted to work in high-tech sectors of the economy of the Republic of Kazakhstan based on the development of priority areas of science and technology, the development of high-tech industries, competitive technologies in the field of processing man-made raw materials and waste.

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

The benefits of the Program are:

– highly qualified continuous training of young scientists and personnel for the university and the economy of the republic according to new methods and specialized Minor - programs;

– active involvement of talented students in priority research (fundamental) and scientific and technical (applied) work;

– participation of students in priority scientific work, the formation of new knowledge and skills, the acquisition of professional work experience (length of service) to continue scientific research in the magistracy and doctoral studies with the development of innovative technologies for the mining and metallurgical industry.

The training of specialists provides for training in the main areas, each of which includes modern fundamental content necessary for the training of highly qualified specialists in demand by the economy of the republic.

The educational program "Metallurgy and mineral processing" is based on the specialties "Metallurgy" and "Mineral processing" and includes fundamental, natural science, general engineering and professional training of bachelors in the field of metallurgy and enrichment in accordance with the development of science and technology, as well as the changing needs of mining -metallurgical industry. A distinctive feature of the program is that the program makes the graduate adaptable to the manufacturing sector, due to the content in the educational program of 40% of general engineering disciplines. A graduate receives a fundamental set of general engineering disciplines, as well as a maximum set of profile disciplines. The program provides an in-depth study of the theory of concentrating and metallurgical processes, metallurgical heat engineering, the theory of furnaces, the design and design of metallurgical units, physical and chemical methods of analysis, software for calculating physical and chemical processes, technological processes for obtaining powder, composite materials and coatings of high quality and increased consumer properties. Graduates have knowledge of the technology of metallurgical production of ferrous, non-ferrous, noble, radioactive, rare and other metals.

The mission of the educational program is to train bachelors-metallurgists and concentrators who know the mineral resource base, enrichment technologies of ore and technogenic raw materials, production technologies and areas of consumption of metals, who have fundamental training in physics, mathematics,

chemistry, physical and chemical foundations of enrichment technologies and metallurgy, processing metals and alloys, production of composite materials and nanomaterials. Providing students with knowledge, skills and abilities that allow them to analyze problems in the field of professional activity and find ways to solve them, solve engineering problems of designing technologies and equipment of plants and factories, conduct experimental research using information technology and mathematical modeling.

Area of professional activity. Specialists who have completed a bachelor's degree perform production, technological and organizational work at industrial enterprises, as well as carry out research work on the enrichment of minerals, the production of ferrous, non-ferrous, rare and radioactive metals, alloys and special materials; processing of metals and alloys; heat treatment of metals and alloys.

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

The subjects of professional activity are the technological processes of the mining and processing and metallurgical industries, the processing of raw materials and the production of metal products with increased consumer properties, technologies for the production and processing of metals and materials, the study of the structure and properties, equipment for mining and metallurgical production, automatic control systems for metallurgical production and quality control end products.

Types of economic activity: screener, batcher, crusher, concentrator, mill operator, washing machine operator, calciner, enrichment products controller, thickener operator, filter operator, equipment maintenance and repair technician, unit repairman, control panel operator, dryer, flotation machine, mineralogical analysis laboratory assistant; moulder, process engineer, converter loading operator, converter steelmaker, smelter, metallurgical technician, molten salt electrolyzer, hydrometallurgical operator, metal and alloy smelter, powder metallurgy equipment designer, new metal designer, eco-recycler in metallurgy, equipment supervisor.

2. Purpose and objectives of the educational program

The purpose of EP "6V07203 - Metallurgy and mineral processing" is:

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

The objectives of the EP "6B07203 - Metallurgy and mineral processing" are:

– combining the efforts of the university and industrial enterprises in conducting scientific research, training and retraining of personnel in the field of studying the principles and patterns of functioning and development of cities and megacities, the features of anthropogenic impacts on objects of the urban environment, the principles of sustainable development of urban areas and measures of their organizational and legal support with ensuring the true interdisciplinarity of education in these areas;

– formation of skills and abilities for choosing and evaluating methods of protecting the environment from anthropogenic impact in urban areas;

– strengthening the technological component of classical natural science education, to give knowledge on modern technologies, without lowering the bar of the level of fundamental education;

– fundamentals for the development and implementation of fundamental and applied research and development in the field of geological exploration and mineral processing, mining and metallurgy using new advances in technology, new generation technology and environmental monitoring 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, the experimental base for the implementation of educational research, laboratory and term papers, industrial and undergraduate practice;

– raising the level of educational and methodological work by creating new curricula, textbooks, teaching and methodological aids, including on electronic media;

– providing 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 high technology innovative companies and other research centers;

– organization of effective interaction with foreign universities for the development of educational standards of a new generation, the implementation of student exchange, the training and retraining of specialists in the mining and metallurgical industry in specialized bachelor's programs;

– implementation of international cooperation in the development of new technologies in the mining and metallurgical industry through the implementation of joint contracts, participation in international conferences, organization of

international exchange of employees, students and young scientists with specialized universities and laboratories of the world, international scientific and educational organizations;

– the formation of theoretical and practical knowledge in the technologies for processing technogenic and secondary raw materials, knowledge in the technologies for the production of ferrous and non-ferrous metals, as well as their alloys and various metal-containing products from technogenic materials and secondary resources.

– formation of theoretical and practical knowledge in the field of processing of critical raw materials and metals, innovative "green" technologies of the metallurgical sector, recycling of metallurgical production waste and environmental restoration.

The modern educational program allows you to specialize in:

– *secondary metallurgy* - an industry that allows you to extract all known metals by processing technogenic raw materials and using secondary resources. The graduate has the ability to analyze raw materials and apply the best method for extracting metals from man-made and secondary raw materials; apply the technologies of pyro-, hydro-, electrometallurgy; with their knowledge and skills can influence the reduction of waste and environmental pollution; influence the optimal fuel consumption, the ability to perform the necessary technical, heat engineering, heat power, metallurgical calculations; carry out the design of workshops and equipment for secondary metallurgy.

– *physical metallurgy* - a branch that provides skills and studies the physical state of metals, their properties, the effects of various media, stress and pressure; testing of metals for compliance with quality and safety standards; perform various kinds of analytical, physico-chemical methods of analysis.

– *technological metallurgy* - an industry where metal parts are designed and the processes in which they are formed are controlled, the graduate has the skills of casting, forging, welding, rolling, etc.

– recycling of metal-containing waste - an industry that allows you to create an environmentally friendly production, with a fairly complete use of production waste and the subsequent restoration of renewable natural resources, reducing environmental pollution, ensuring the integrated use of raw materials, environmental protection, resource and energy saving and waste disposal.

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

B - basic knowledge, skills and abilities

B1 - know the history of the Republic of Kazakhstan, the stages and prospects for the development of the state;

B2 - the ability to use modern technologies to access and exchange information sources. Have the skills to work on a computer as a means of managing, storing and processing information and performing calculations using general and applied software products.

B3 - to speak state, Russian and one of the most common foreign languages in the industry at a level that ensures human communication.

B4 - be able to use fundamental general engineering knowledge, the ability to practically use the basics and methods of mathematics, physics and chemistry in their professional activities.

B5 - the ability to use the knowledge and methods of general engineering disciplines (basics of automation and mechanics) in practical activities.

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

B7 - familiarization with technological processes and skills in working at metallurgical enterprises.

B8 - know and own the main business processes in an industrial enterprise.

B9 - know the basics of military training and be able to work with military equipment.

P - professional competencies, including in accordance with the requirements of industry professional standards

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

P2 - possession of professional terminology and the ability to work with educational and scientific materials in the specialty in the original in the state, Russian and foreign languages. The ability to logically correctly, argue, and clearly build oral and written speech in three languages

P3 - knowledge of the requirements of the Rules of safety and labor protection at work and the ability to use them in practice.

P4 - possession of a culture of professional safety; the ability to identify hazards and assess risks in their field; possession of the main methods of protecting production personnel and the population from the possible consequences of accidents, catastrophes, natural disasters and improving working conditions in the field of professional activity.

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

P6 - the ability to use regulatory legal documents in their activities.

P7 - choose rational methods for the production and processing of ferrous and non-ferrous metals that meet the requirements of integrated technology, economics and ecology.
P8 - be able to realize the social significance of their future profession. Possess knowledge of the formation and development of the mining and processing and metallurgical industry of Kazakhstan and modern priority trends
P9 - be able to combine problem theory and practice to solve engineering problems, carry out balance heat engineering, hydraulic, aerodynamic calculations of metallurgical processes and apparatus, based on practical data.
P10 - be able to apply in practice the principles of rational use of natural resources and environmental protection.
P11 - be able to choose measuring instruments in accordance with the required accuracy and operating conditions.
P12 - be able to implement and adjust technological processes in metallurgy.
P13 - be able to identify objects for improvement in engineering and technology.
P14 - the ability to identify concentrating and metallurgical apparatuses and systems for transporting melts (reagents, slurries, etc.) that have a low efficiency, an increased level of danger, and determine the necessary measures to improve equipment and / or production technology.
P15 - be able to apply the methods of technical and economic analysis. Calculate and analyze chemical and physico-chemical processes, mass transfer processes occurring in the technological processes of processing (enrichment) of mineral raw materials, production and processing of ferrous and non-ferrous metals.
P16 - be able to choose research methods, plan and conduct the necessary experiments, interpret the results and draw conclusions.
P17 - to calculate and analyze the processes of fuel combustion and heat release, external and internal heat transfer in furnaces for various technological purposes, to choose rational temperature and thermal modes of operation of metallurgical furnaces. Calculate and analyze hydrometallurgical processes and apparatuses, choose the optimal technological regimes.
P18 - have the ability to analyze and synthesize. Conduct literary and analytical reviews.
P19 - be able to use the basic concepts, laws and models of thermodynamics, chemical kinetics, heat and mass transfer. Be able to select and apply appropriate methods for modeling physical, chemical and technological processes.
P20 - be able to carry out elements of projects.
P21 - independently perform: calculations of pyro- and hydrometallurgical equipment; drawings of parts and structural elements; strength and stiffness calculations; calculations of parts of machines and mechanisms; choose electrical equipment and calculate its operating modes; offer an automation system for the main equipment.
P22 - be able to justify the choice of equipment for the implementation of technological processes.
P23 - conduct a feasibility study of the metallurgical process. Plan the volume of production and perform cost calculations for the production and sale of products,

determine the break-even conditions. Carry out approximate calculations of harmful emissions and assessment of the ecological state of existing and planned technological processes and units.

P24 - independence: implementation of independent work in typical situations and under guidance in difficult situations of professional activity; independent organization of training. Responsibility: for the results of work; for your own safety and the safety of others; for meeting environmental and fire safety requirements. Complexity: solving typical practical problems; choice of a method of action from known ones based on knowledge and practical experience: maintaining the main technological process in accordance with their area of professional activity.

O - universal, social and ethical competencies

O1 - in work and everyday life, show respect for the environment.

O2 - take into account ethical and legal norms in interpersonal communication, knowledge and understanding of their rights and obligations as a citizen of the Republic of Kazakhstan.

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

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

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

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

C - special and managerial competencies

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

C2 - independence: executive and managerial activities for the implementation of tasks under the leadership, providing for the independent definition of tasks, organization and control of the implementation of its subordinate employees. Responsibility: for the results in the implementation of the norm; for your own safety and the safety of others; for meeting environmental and fire safety requirements. Complexity: solving various typical practical tasks that require independent analysis of work situations: Maintaining the main technological process in the field of one's professional activity, of various levels of complexity, mentoring in a team. Quality control of semi-finished products, technological processes and finished products.

C3 - independence: management activities within the framework of the technological process section and the strategy of the enterprise. Responsibility: for the evaluation and improvement of one's own work, one's own training and the training of others; for your own safety and the safety of others; for meeting

environmental and fire safety requirements.
Complexity: solving practical problems based on the choice of solutions in various changing conditions of working situations: Conducting work on organizing the technological process of production of the mining and metallurgical industry of design, carrying out work on the development and implementation of new equipment, technologies and assortment, organizational and managerial work to improve quality production and production efficiency of the mining and metallurgical industry.
C4 - independence: management activities within the framework of the enterprise's activity strategy, involving the coordination of work with other areas. Responsibility: for planning and developing processes of activity that can lead to significant changes or development, responsibility for improving the professionalism of employees. Complexity: activities aimed at solving problems involving the choice and variety of solutions. Carrying out research and experimental work, designing the expansion and modernization of production, expanding and updating the range of the mining and metallurgical industry, introducing new technologies.
Description of general mandatory standard requirements for graduation from the university and the award of the academic degree of bachelor: the development of at least 240 academic credits of theoretical training and the final thesis.

Special requirements for graduating from a university in this EP:

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

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

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

- upon completion of the internship, the student contacts the supervisor in writing or orally and reports on the results of the work, but no more than a week after the start of the 4th year of study;

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

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

4. Passport of the educational program

4.1. General information

№	Field name	Note
1	Code and classification of the field of education	6B07 - Engineering, manufacturing and construction industries
2	Code and classification of 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 and mineral processing
5	Brief description of the educational program	The educational program "Metallurgy and mineral processing" includes fundamental, natural science, general engineering and professional training of bachelors in the field of metallurgy and mineral processing in accordance with the development of science and technology, as well as the changing needs of the mining and metallurgical and mining and processing industries.
6	Purpose of the EP	Training of competitive personnel with critical thinking, fundamental and applied knowledge, research skills in the field of metallurgy and mineral processing, capable of making comprehensive and effective decisions in the processing of mineral raw materials from concentrates to metals and their compounds
7	EP type	New
8	NQF level	Level 6 - higher education and practical experience
9	ORC level	Level 6 - a wide range of special (theoretical and practical) knowledge (including innovative). Independent search, analysis and evaluation of professional information
10	Distinctive features of the EP	No
11	List of competencies of the educational program:	See 4.2 Matrix for correlating the learning outcomes of the educational program as a whole with the formed competencies
12	Learning outcomes of the educational program:	
13	Form of study	full-time
14	Training period	4 years
15	Volume of loans	240
16	Languages of instruction	Kazakh/Russian
17	Awarded Academic Degree	Bachelor of Engineering and Technology
18	Developer(s) and authors:	Barmenshinova M.B. Chepushtanova T.A.

4.2. Matrix of correlating the learning outcomes of the educational program as a whole with the formed competencies

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

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

№	Name of the discipline	Brief description of the discipline	Amount of credits	Formed learning outcomes (codes)							
				PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Цикл общеобразовательных дисциплин Обязательный компонент											
1	Foreign language	After determining the level (according to the results of diagnostic testing or IELTS results), students are divided into groups and disciplines. The name of the discipline corresponds to the level of English proficiency. When moving from level to level, prerequisites and postrequisites of disciplines are observed.	10	V							
2	Kazakh (Russian) language	The socio-political, socio-cultural spheres of communication and functional styles of the modern Kazakh (Russian) language are considered. The course covers the specifics of the scientific style in order to develop and activate professional communication skills and abilities of students. The course allows students to practically master the basics of the scientific style and develop the ability to produce a structural and semantic analysis of the text.	10	V							
3	Physical Culture	The purpose of the discipline is to master the forms and methods of forming a healthy lifestyle within the framework of the vocational education system. Acquaintance with the natural-scientific foundations of physical education, possession of modern health technologies, the main methods of independent physical education and sports. And also within the framework of the course, the student will master the rules of refereeing in all sports.	8	V							
4	Information and Communication Technologies (in English)	The task of studying the discipline is to acquire theoretical knowledge about information processes, new information technologies, local and global computer networks, methods of information protection; obtaining skills in the use of text editors and spreadsheet processors; creation of databases and various categories of application programs.	5				V				
5	Modern history of Kazakhstan	The course studies historical events, phenomena, facts, processes that took place on the territory of Kazakhstan from ancient times to the present day. The sections of the discipline include: introduction to the history of Kazakhstan; the steppe empire of the Turks; early feudal states on the territory of Kazakhstan; Kazakhstan during the Mongol conquest (XIII century); medieval states in the XIV-XV centuries. The main stages of the formation of Kazakh statehood are also considered: the era of the Kazakh Khanate of the XV-XVIII	5		V						

		centuries. Kazakhstan within the Russian Empire; Kazakhstan in the period of civil confrontation and in the conditions of a totalitarian system; Kazakhstan during the Great Patriotic War; Kazakhstan in the period of formation of independence and at the present stage.										
6	Philosophy	Philosophy forms and develops critical and creative thinking, worldview and culture, provides knowledge about the most general and fundamental problems of being and endows them with a methodology for solving various theoretical practical issues. Philosophy expands the horizon of vision of the modern world, forms citizenship and patriotism, contributes to the education of self-esteem, awareness of the value of human existence. It teaches to think and act correctly, develops the skills of practical and cognitive activity, helps to seek and find ways and means of life in harmony with oneself, society, and the world around.	5				V					
7	Module of socio-political knowledge (sociology, political science)	The purpose of the course: the formation of theoretical knowledge about society as an integral system, its structural elements, connections and relationships between them, the features of their functioning and development, as well as the political socialization of students of a technical university, ensuring the political aspect of training a highly qualified specialist based on modern world and domestic political thought . The tasks of mastering the discipline: the study of the basic values of social and political culture and the willingness to rely on them in their personal, professional and general cultural development; study and understanding of the laws of development of society and the ability to operate this knowledge in professional activities; the ability to analyze social and political problems, processes, etc.	3				V					
8	Module of socio-political knowledge (culturology, psychology)	It is designed to acquaint students with the cultural achievements of mankind, to understand and assimilate the basic forms and universal patterns of the formation and development of culture, to develop their desire and skills to independently comprehend the entire wealth of values of world culture for self-improvement and professional growth. During the course of cultural studies, the student will consider the general problems of the theory of culture, leading cultural concepts, universal patterns and mechanisms for the formation and development of culture, the main historical stages of the formation and development of Kazakhstani culture, its most important achievements. In the course of studying the course, students acquire theoretical knowledge, practical skills and abilities, forming their professional	3			V						

		orientation from the standpoint of psychological aspects.									
Cycle of general education disciplines Selectable Component											
9	Fundamentals of anti-corruption culture	It reveals the general patterns of the emergence, development and functioning of an anti-corruption culture, and other social phenomena and processes organically related to them.	5			V					
10	Fundamentals of Entrepreneurship and Leadership	Students will study the theory and practice of entrepreneurship as a system of economic, organizational and legal relations between business structures. The discipline is aimed at revealing the content of entrepreneurial activity, career stages, qualities, competencies and responsibilities of a modern entrepreneur, as well as theoretical and practical business planning and economic examination of business ideas. They will develop their leadership and teamwork skills.	5			V					
11	Ecology and life safety	Brief history of ecology. Ecology of individuals (Autecology); organism and environment. Ecology of populations (Demecology). Ecology of communities (Synecology). Ecosystems. Biosphere and its sustainability. Biomes. Ecological problems of the present. Sustainable development: concept, indicators, goals of sustainable development. Measures of sustainable development: "green economy", "green" technologies. Natural resources and rational nature management. Environmental measures for sustainable development in the World and Kazakhstan. Environmental security as a component of the national security of Kazakhstan. Life safety (BZhD) in the technosphere. Emergency situations of natural and technogenic nature. Organizational bases for the protection of the population from emergencies. Sustainability of production in emergency situations. Basic safety requirements for industrial equipment. Occupational injury and its main causes. Investigation, accounting and methods of analysis of the causes of industrial injuries in mining and oil production. Working conditions and basic requirements for ensuring safe working conditions. Impact on the body of chemically hazardous substances Microclimate and comfortable living conditions. Systems for providing microclimate parameters. Industrial lighting. Protection against vibration, noise, ultra- and infrasounds. Protection against electromagnetic fields and laser radiation. Protection against ionizing radiation. Lightning protection, static electricity, electrical safety. Safety of equipment under pressure. Safe operation of cranes. Fire and explosion safety. Systems and means of ensuring fire safety.	5			V					
Cycle of basic disciplines											

University component											
12	Mathematics I	The course is based on the study of mathematical analysis in a volume that allows you to explore elementary functions and solve the simplest geometric, physical and other applied problems. The main attention is paid to differential and integral calculus. The sections of the course include differential calculus of functions of one variable, derivative and differentials, study of the behavior of functions, complex numbers, polynomials. Indefinite integrals, their properties and methods of calculation. Definite integrals and their applications. Improper integrals.	5	V							
13	Mathematics II	The discipline is a continuation of Mathematics 1. The sections of the course include: elements of linear algebra and analytic geometry. Differential calculus of a function of several variables and its applications. Multiple integrals. The objectives of the course are to instill in students solid skills in solving mathematical problems with bringing the solution to a practically acceptable result. To develop the primary skills of mathematical research of applied issues and the ability to independently understand the mathematical apparatus contained in the literature related to the student's specialty.	5		V						
14	Physics I	The course studies the basic physical phenomena and laws of classical and modern physics; methods of physical research; the influence of physics as a science on the development of technology; connection of physics with other sciences and its role in solving scientific and technical problems of the specialty. The course covers the following sections: mechanics, dynamics of rotational motion of a solid body, mechanical harmonic waves, fundamentals of molecular kinetic theory and thermodynamics, transfer phenomena, continuum mechanics, electrostatics, direct current, magnetic field, Maxwell's equations.	5	V							
15	Engineering and computer graphics	The course develops the following skills for students: depict all possible combinations of geometric shapes on a plane, conduct research and measure them, allowing image transformations; create technical drawings, which are the main and reliable means of information that provide communication between the designer and the designer, technologist, builder. Introduces students to the basics of automated preparation of the graphic part of design documents in the AutoCAD environment.	5	V							
16	General chemistry	The purpose of the discipline is to study the basic concepts and laws of chemistry; fundamental laws of chemical thermodynamics and kinetics; quantum-mechanical theory of the structure of the atom and	5		V						

		chemical bonding. Solutions and their types, redox processes, coordination compounds: formation, stability and properties. Structure of matter and chemistry of elements.										
17	Physical chemistry	To form in students: the ability to understand the physical and chemical essence of processes and use the basic laws of physical chemistry in complex production and technological activities. After mastering this discipline, the student must know: the laws of thermodynamics; basic equations of chemical thermodynamics; methods of thermodynamic description of chemical and phase equilibria in multicomponent systems; properties of solutions; fundamentals of electrochemistry; basic concepts, theories and laws of chemical kinetics and catalysis.	5				V				
18	Technological mineralogy	General information about mineralogy. Formation of minerals in nature. Basic concepts about crystals. Properties of minerals and their classification. The properties of minerals used in the processing of various mineral raw materials to obtain metals have been studied. The concept of minerals and deposits. Mineral deposits of the Republic of Kazakhstan.	4			V						
19	Fundamentals of mineral processing	The processes of preparation of mineral raw materials for enrichment, the main regularities used in their implementation, the processes of separation of minerals based on the contrast of physical and physico-chemical properties, the laws of physics and chemistry underlying these processes, auxiliary processes implemented in the technologies of enrichment of solid minerals, designs of devices used in various stages of mineral processing technologies, wastewater treatment technologies and waste storage of processing plants, quality control of manufactured products, enrichment studies.	6			V						
20	Ore preparation processes and equipment	Ore preparation is widely used in the processing of ores of ferrous and non-ferrous metals, rare metal and gold-bearing raw materials, as well as non-metallic raw materials, building materials and other areas of the national economy of the Republic of Kazakhstan. This course studies in detail the technological processes of ore preparation and enrichment, the design of the equipment used, the methods for calculating and selecting the main and auxiliary equipment, the operation of crushing and grinding equipment.	5			V						
21	Gravity enrichment methods	This course studies in detail: Theoretical foundations of gravity enrichment; Hydraulic and pneumatic classification processes and apparatuses; Enrichment in heavy environments; Enrichment with jigging; Enrichment in the flow of water flowing along an inclined surface; Pneumatic enrichment; Washing of ores.	5				V					

22	General metallurgy	Cast iron and iron production: raw materials and their preparation; blast furnace design; domain process; equipment and operation of sections serving the blast furnace; performance indicators of blast furnaces; methods of non-domain (coke-free) production of iron. Steel production: general principles of steelmaking; converter steel production; open-hearth steel production; steel smelting in electric furnaces; ingots and steel casting; continuous casting of steel; modern technologies for producing high quality steel; out-of-furnace processing of steel; complex technologies for out-of-furnace processing of cast iron and steel; steel production in continuous units; melting processes. Production of non-ferrous metals: copper metallurgy; nickel metallurgy; aluminum metallurgy; receiving other non-ferrous metals.	5					V			
23	Theory of metallurgical processes I	Theory of pyro-, hydro- and electrometallurgical processes: basic laws, kinetics and thermodynamics of reactions, as well as properties of metallurgical melts. Processes such as segregation, recrystallization, distillation, rectification, dissolution, extraction, ion exchange, cementation and precipitation of metals and oxides from solutions with gases, etc. are described.	5					V			
24	Theory of metallurgical processes II	Theory of segregation methods of metal refining, evaporation, sublimation, condensation and sublimation processes, properties of oxide and sulfide melts, thermodynamics and kinetics of metal oxidation, carbon and oxide reduction processes, physical and chemical foundations of sulfide processing. Thermodynamics and kinetics of leaching, extraction and sorption processes.	5					V			
25	Metallurgy of heavy non-ferrous metals	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 methods of processing: roasting, melting, converting, fire refining, leaching, purification of solutions, electrolysis and their instrumentation. Methods for processing middlings and new technologies to increase the complexity of the use of heavy non-ferrous metals in metallurgy.	5					V			
26	Metallurgy of precious metals	Properties and scope of noble metals and their compounds. Sources of raw materials and the history of the development 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 primary and placer ores and	5					V			

		extraction of precious metals from them. Refining of precious metals. Hardware design of the main processes. Methods for the associated extraction of precious metals from middlings and wastes of metallurgical production. New technologies in the metallurgy of noble metals.										
27	Metallurgical heat engineering	Technical thermodynamics. Introduction to metallurgical heat engineering. Heat generation due to the chemical energy of fuel and electricity. Basic provisions of the theory of heat transfer. Heat transfer by conduction. Heat transfer by convection. Heat transfer by radiation. Mechanics of liquids and gases. Fundamentals of the theory of similarity and modeling. Fundamentals of the general theory of furnaces. Thermal work and design of kilns and kilns. Melting and foundry furnaces. Refractory materials. Energy equipment. Use of secondary energy resources.	5					V			
28	Thermal power engineering of metallurgical processes	Basic concepts and definitions of the working fluid and its main parameters, analysis of the fundamental laws of thermodynamics, thermodynamic processes, differential equations of thermodynamics, outflow and throttling of gases and vapors. The mutual transformation of heat into work, the relationship between thermal, mechanical and chemical processes that take place in thermal and cooling mechanisms. Heat generation due to the chemical energy of fuel and electricity. Basic provisions of the theory of heat transfer.	4					V			
29	Metallurgical Engineering (in English)	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 metal melts. Fundamentals of the interaction of metallic and oxide phases. Kinetics of processes. Preparation of raw materials for the metallurgical process. Classification of metals. Metallurgy of ferrous metals. Manufacture of iron and steel. Metallurgy of non-ferrous metals. Hydrometallurgy. Pyrometallurgy. Metallurgical calculations	5						V		
Cycle of basic disciplines Optional component												
30	Theory and technology of steelmaking processes	Prospects for the development of steelmaking production. The concept of steel, the classification of steel according to purpose, quality, composition, behavior in molds, production method. Steel marking. General scheme of production. Steel deoxidation methods, advantages and disadvantages. Features of the smelting of alloyed steels. Influence of alloying elements on the properties of steel. direct doping. Development of converter steel production. Steel production in continuous steelmaking plants.	5			V					

31	Powder metallurgy	Classification of methods for obtaining powder materials. Mechanical methods for obtaining powder materials. Reducers used in powder metallurgy. Obtaining powders by methods of reduction of chemical compounds of metals. Examples of obtaining powder metals by methods of high-temperature reduction of chemical compounds. Obtaining powder recovery materials from solutions.	5			V					
32	Magnetic and special enrichment methods	Magnetic properties of minerals, Theory of magnetic fields of magnetic separators. Classification of magnetic separators. The structure and dynamics of movement of mineral particles in them. The practice of using magnetic separators and auxiliary devices. Obtaining artificial concentrates from mineral raw materials that cannot be enriched. Combined processes of processing of mineral raw materials (combination of enrichment processes and metallurgical operations). Fine-tuning of substandard concentrates.	5				V				
33	Theory and technology of preparation of technogenic and secondary raw materials of ferrous and non-ferrous metallurgy for metallurgical processing	Scrap metal as a man-made raw material for metallurgical enterprises. Material and energy saving in the recycling of scrap metal. Technologies for the preparation of ferrous and non-ferrous metals used in metallurgical enterprises. The concept of elements - "vagants". Their influence on the quality of products from ferrous metals and metallurgical technologies. Circulation of "vagant" in the technological cycle of metallurgical enterprises. Modern standards of the EU, USA and Japan, taking into account the presence of "vagant" in metallurgical raw materials. Preparation of technogenic energy resources. Plastics, MSW, used oils and lubricants. Methods for the environmentally safe use of technogenic energy resources in metallurgical production.	5				V				
34	Experimental foundations in metallurgy	Formation of knowledge, skills and abilities in the field of metallurgical experiment technology and their application in professional activities. Objectives of the course: to convey basic theoretical knowledge on the course "Metallurgical Laboratory"; to teach how to solve typical tasks for the implementation of a metallurgical experiment; to form students' skills of practical work in the laboratory for research of metallurgical processes and systems.	5					V			
35	Flotation reagents in MP	Basic theories of flotation in its current state. The methods for studying the action of flotation reagents and the mechanism of the flotation process are described in detail, as well as the processing of the results obtained. The fundamentals of the theory and practice of using flotation reagents in the flotation of non-ferrous ores and accompanying rare metals are outlined. The structure and composition, physical and chemical properties of the reagents are	5					V			

		described.									
36	Special electrometallurgy	Basic laws of theoretical and applied electrochemistry. Technological foundations of electrorefining and electrodeposition of non-ferrous metals in aqueous and molten media, electroplating of the surface of products, as well as obtaining metal powders under electrolysis conditions.	5						V		
37	Corrosion and protection of metals	Classification of corrosion processes. Films on metals. Mechanism of diffusion in protective films. electrochemical corrosion. Thermodynamics of electrochemical corrosion. Secondary processes and products of electrochemical. Classification of protection methods. Methods of protection against chemical and electrochemical corrosion.	5						V		
38	Processes and equipment for enrichment production	The course deals with the theoretical foundations of the processes, describes the design of typical devices and methods for their calculation, highlights the issues of servicing the devices.	5						V		
39	Autogenous processes in metallurgy	Issues of theory and practice of modern autogenous processes for the processing of non-ferrous metal raw materials (KIVCET, PZhV, Outokumpu-Ou, QSL, Ausmelt, Isasmelt, etc.). Technological schemes of production, design and principle of operation of metallurgical units, the main technical and economic indicators of processes.	5						V		
40	Composite materials technology	Definition and classification of composite materials. Basic concepts of the mechanics of composite materials: modulus of elasticity, strength, destruction, chemical, thermal and mechanical stability. Components used in the production of composite materials: matrix and reinforcing materials and their production.	6							V	
41	Auxiliary facilities in the MP	The discipline studies the theoretical foundations of the processes of dehydration and dust collection, the design and principle of operation of apparatuses used for drainage, centrifugation, thickening, filtering, drying and dust collection. Methods for the selection and calculation of the main auxiliary equipment and dehydration schemes are considered. The relationship of auxiliary facilities with the technological processes of enrichment. Methods of calculations and selection of auxiliary equipment.	6							V	
Cycle of major disciplines University component											
42	Metallurgy of ferrous metals	Raw material base of ferrous metallurgy. Basic minerals, ore quality, supply of iron, manganese, chromium ores to metallurgical enterprises. The main deposits of coal and flux-forming. Preparation of raw materials for melting. Obtaining coke, coke battery.	5							V	

		Preparation of ores for smelting. Crushing, separation, enrichment of ores. Production of sinter and pellets. Processes occurring during sintering of sinter and firing of pellets. Cast iron smelting.										
43	Metallurgy of light metals	Methods for opening ores, concentrates, middlings containing light metals. Processing of compounds of light metals by hydro- and pyrometallurgical methods of concentration, separation in order to obtain pure compounds and their further processing by methods of rectification, electrolysis, thermal processes.	5							V		
44	Metallurgy of secondary raw materials	The course "Metallurgy of secondary raw materials" examines the main processes in hydrometallurgy. Theoretical bases and technological schemes of leaching processes. Non-oxidizing and oxidizing leaching of metallurgical raw materials. Hydro - and electrometallurgical processing of sulfide materials. Theory and practice of extraction and sorption processes. Fundamentals of precipitation processes of poorly soluble compounds. Thermodynamics of electrochemical processes in the processing of metallurgical raw materials and the production of metals.	6							V		
45	Flotation enrichment methods	The physical and chemical foundations of the flotation process are considered. Reasons for the appearance of free energy at interphase boundaries. The use of flotation reagents to control the change in energy at the phase boundaries. Adsorption processes at phase separations. Classification of flotation reagents and their role in flotation. The mechanism of action of the reagents. Flotation machines, features of their designs and applications. Flotation enrichment schemes. Brief information about the use of reagents in the flotation enrichment of various types of ores.	4						V			
		Cycle of major disciplines Selectable Component										
46	Man-made waste processing processes	The course "Processes of processing of technogenic wastes" considers the main ways of processing technogenic raw materials of some heavy non-ferrous, noble, light and rare metals. In particular, the main sources of waste generation, their classification and characteristics are 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 man-made waste, basic technological schemes and instrumentation for the production of basic heavy, rare, light and noble metals from lumpy waste, slag, dust, sludge, industrial solutions and a number of other man-made waste are covered.	5					V				

47	Receipt, quality and certification of by-products during recycling	Peculiarities of metallurgical processes during melting "to slag". Blast-furnace melting with the use of technogenic materials and obtaining slag of a given composition. Regularities of mass transfer between metal and slag. Formation of neutral compositions of elements - "vagants". By-products of coke production. The use of finely dispersed carbon-containing man-made materials in the production of coke. Slag processing. Vitrification of potentially hazardous and toxic compounds. Obtaining metallurgical gases of a given composition using technogenic raw materials. Quality and certification of by-products.	5					V			
48	Consumer properties of metallurgical products	Classification of metallurgical products, quality control methods, requirements for consumer properties of metallurgical products, fixed in the standardization and certification system, specific consumer properties of metallurgical products obtained from secondary and technogenic raw materials. Methods and technologies used for the process of management and quality control of metallurgical products obtained from secondary and technogenic raw materials	5					V			
49	Geotechnology in metallurgy	Geochemical processes in the earth's crust. Formation of minerals and deposits of non-ferrous and ferrous metals. Methods of geotechnology. Possibilities of extraction of metals by geotechnological methods. Choice of geotechnology method of metal mining in accordance with the nature and condition of the ore reserves. Underground, borehole and group leaching. Influence of the nature of the reagent on the extraction of metals.	5					V			
50	Special and combined enrichment methods	Special methods of enrichment, ore sorting of mineral raw materials (manual and automatic) to improve the quality of raw materials and extract valuable minerals. Mineral raw materials that cannot be enriched and methods for their processing using combined processes (enrichment and metallurgy). Refinement of concentrates that are conditioned in terms of the base metal, but defective in terms of impurities. Processing of collective concentrates obtained by enrichment methods using pyro- and hydrometallurgical operations.	5					V			
51	Geotechnological enrichment methods	Methods of geotechnological extraction of minerals, in order to determine the possibility of transferring the extracted useful components into a mobile state. The issues of physical and chemical foundations of geotechnological processes are considered. The schemes of geotechnological processing of uranium, gold, manganese, iron ores and non-metallic minerals are studied, and the processes of processing products of geotechnologies are considered.	5					V			
52	Alloys of non-ferrous and ferrous metals	The main processes of melting alloys of non-ferrous and ferrous	4					V			

		metals include issues of a theoretical, technological and constructive nature in the field of traditional and new metallurgy processes. Acquisition of competencies in the analysis of metal production technologies, the development of technological schemes and designs of metallurgical units and the conduct of technological calculations.										
53	Design of metallurgical units in ferrous metallurgy	The main advanced designs of melting, heating and thermal furnaces; methods of calculation, design of units and optimization of their technological parameters.	4					V				
54	Processing of uranium and rare metal raw materials of Kazakhstan	Prospects for the use of atomic energy for peaceful purposes, world reserves of uranium, its mineral sources. Properties of uranium, forms of its presence in aqueous solutions. Methods for preparing ores for hydrometallurgical processing. Radiometric and mechanical enrichment of uranium ores, their acid and carbonate leaching. Extraction of uranium from poor and off-balance ores. Chemistry of rare earth elements. Methods for extracting REE from various types of mineral raw materials.	4					V				
55	Theory and practice of metal refining	Methods for the separation, concentration and purification of metals (extraction, ion exchange, electrolysis and electrodialysis, crystallization from solutions and melts, purification and separation of metals by vacuum and gas-phase metallurgy, etc.), instrumentation of technological processes, engineering methods for calculating the purification of metals.	4					V				
56	Testing and control of enrichment processes	Basic concepts about the process of testing minerals, products of their enrichment, control of technological processes at processing plants. List of controlled parameters. Methods and technical means of sampling from immobile materials and from moving masses. Determination of the minimum amount of sample from the mass of the batch being tested. Minimum mass of incremental sample. The minimum mass of a sample for analysis: chemical, granulometric, fractional. Sample preparation. Control of enrichment processes. Technological and commodity balance. Organization of testing and control.	4						V			
57	Study of ores for washability	Methods for taking technological samples, preparing them for analysis for washability, drawing up sample cutting schemes, the material and mineralogical composition of ore using various methods of analysis, the use of experiment planning, the methodology for conducting schematic experiments, the procedure for conducting semi-industrial and industrial tests, the methodology for compiling research reports.	4						V			
58	Processes and devices in ferrous	The discipline "processes and apparatus in ferrous metallurgy"	6						V			

	metallurgy	studies existing and new processes and apparatus for the production of ferrous metals and their chemical compounds.										
59	Processes and devices in non-ferrous metallurgy	Theoretical regularities of hydromechanical, thermal and mass transfer processes in metallurgy; hardware design of these processes; production of analysis of technological processes and necessary calculations.	6						V		
60	Metallurgical furnaces	The main types of fuel and its combustion, classification and general characteristics of the operation of furnaces, materials used in furnace building, elements and design of a number of furnaces used in non-ferrous and ferrous metallurgy.	6						V		
61	Types of coatings on metals and processes for their production	Formation of knowledge, skills and abilities in the field of theory and technology of obtaining coatings on metals. Course objectives: to convey basic theoretical knowledge on the course "Types of coatings on metals and processes for their production"; to teach how to solve typical problems on the processes of obtaining coatings on metals and methods for controlling their quality; to form students' analytical thinking skills in the field of coating technology, depending on the raw materials used and methods for obtaining coatings on metals.	6						V		
62	Enrichment of gold and uranium ores	Technology for processing gold ores using enrichment and metallurgical operations. Refining. Associated gold recovery during the processing of copper and zinc concentrates. Technologies for processing secondary raw materials containing precious metals. Material composition of uranium ores. Technology for processing uranium ores. Refining. Associated extraction of rare metals during the processing of uranium raw materials.	6						V		
63	Modeling of enrichment processes	Methods for compiling models of enrichment processes. Obtaining high technological indicators by performing experiments using mathematical planning methods. Compilation of planning matrices, evaluation of the dispersion of experiments, determination of the adequacy of the resulting model and its application. General questions of modeling production systems. Application of theoretical relationships and statistical methods for the mathematical description of enrichment processes.	6						V		
64	Dust collection and gas cleaning in non-ferrous metallurgy	Processes occurring in various gas cleaning devices, design of dust collectors (cyclones, filters, scrubbers, etc.), conditions and features of their operation, as well as methods for their calculation. The advantages and disadvantages of each dust collecting device are considered, an analysis of their application areas is given. The schemes used to clean gases from dust and harmful gaseous components in various workshops of ferrous and non-ferrous	5						V		

		metallurgy enterprises are being studied.									
65	Metallurgy of lead and zinc	Technological schemes and physical and 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 instrumentation of the production processes of these metals are covered. The processes of preparation of raw materials for metallurgical processing, processes of reduction smelting in shaft furnaces, processes of roasting, leaching, purification of solutions from impurities, fire refining, electrolytic refining in aqueous media with the production of commercial lead and zinc are studied. New technologies in the production of lead and zinc are considered.	5						V		
66	Heat and mass transfer of metallurgical processes	General information about mass transfer processes, basic concepts and definitions. Methods for expressing phase compositions. balance between phases. Mass transfer equation. Material balances of mass transfer processes. The mechanism of mass transfer processes. The driving force of mass transfer processes. The rate of mass transfer processes. General information about heat exchange processes, basic concepts and definitions. Heat transfer surface, stationary and non-stationary heat transfer processes, methods of heat transfer. Thermal balances. Heat transfer equations.	5							V	
67	Processes and apparatuses of powder metallurgy	Production of metal powders by mechanical methods. Obtaining iron powders by reduction methods. Production of tungsten and molybdenum powders by reduction methods. Carbonyl method for obtaining metal powders.	5							V	
68	Enrichment of polymetallic ores	Ores of non-ferrous metals are a complex raw material and a source of obtaining not only non-ferrous, but also rare, noble, rare earth metals, sulfur, barite, fluorite, quartz, feldspars and other elements, and minerals that are essential for various sectors of the national economy of the Republic of Kazakhstan. The course is devoted to the study of the variety of technological schemes, reagent regimes and methods for the enrichment of polymetallic ores.	5							V	
69	Enrichment of ores of rare metals	Types and deposits of ores of rare metals. Their technical characteristics and classification by chemical and mineralogical composition. Preliminary enrichment of ores and placers of rare metals. Ore preparation operations in the processing of ores and placers of rare metals. Technology of enrichment and integrated use of the main types of ores and placers (tungsten and tungsten-molybdenum, tin and tin-polymetallic ores, titanium-zirconium ores and placers, tantalum-niobium ores and placers, etc.)	5							V	

70	Ferroalloy metallurgy	Prospects for the development of ferroalloy metallurgy. The essence and classification of electrical methods of heating and melting. The main groups of ferroalloys smelted in ferroalloy shops.	5							V	
71	Metallurgy of copper and nickel	Theoretical foundations of traditional and modern technological processes for the production of copper and nickel. Designs of metallurgical units and principles of their work. Regime parameters and indicators of processes.	5							V	
72	Converting metallurgy and product design	The course "Current metallurgy and product design" considers the processes and technologies of the 2nd stage - refining of ferrous metals, production of steel and alloys, methods of processing scrap metal; processes and technologies of the 3rd redistribution - processing of metals by pressure in order to obtain metal products of a given design; processes and technologies of the 4th redistribution - additional processing of rolled products; production of hardware; processing of pig slags, as well as modern design methods using 3D product modeling.	5							V	
73	Enrichment of mining-chemical and non-metallic raw materials	The discipline deals with the processing of mining and chemical raw materials, the equipment used, the principles for choosing processing schemes and evaluating technical and economic indicators, analyzing the material and mineralogical composition of the ore to choose the most effective technological scheme for enrichment. General information about mining and chemical raw materials and raw material base is given. Consumer requirements for enrichment products. The current state in the field of enrichment and processing, the prospects for further development of this industry.	5							V	
74	Enrichment of ores of ferrous metals	The material composition of ore raw materials. Theoretical foundations and features of the enrichment of various ores of ferrous metals. Principles and conditions for the separation of ore minerals from intergrowths with non-metallic minerals, dressing of ores and its determination. Classification of methods and processes of ore beneficiation based on separating forces. Schemes and apparatus for enrichment of magnetite, titanomagnetite and other ores of complex composition, oxidation of iron ores and quartzites, brown iron ore, manganese and chromium ores, carbonate iron and manganese ores. Experience in the work of factories for the enrichment of ferrous metal ores. Ways of integrated use of mineral raw materials of ferrous metals.	5							V	
75	Foundry production of metals and alloys	The properties of the most widely used metals and casting alloys are discussed, the conditions and methods for preparing alloys determined by these properties are discussed, the basics of filling a	5							V	

		casting mold with a melt are outlined, the regularities of crystallization of alloys under real conditions are considered, the processes of solidification of cast billets and their effect on crystallization and properties of alloys in cast blanks.										
76	Metallurgy of radioactive and related metals	Issues of a theoretical and applied nature concerning the processing of raw materials containing radioactive elements, as well as the technology for the production of pure radioactive and associated metals, in particular uranium and RMZ.	5									V
77	Production of special purpose alloys	Features of technologies for obtaining pure refractory metals. Trends in the development of metallurgy of refractory metals in the XXI century. Prospects for the use of refractory metals. Preparation of alloys based on refractory metals by direct synthesis and reduction methods. Obtaining alloys based on refractory metals by the methods of deposition from the gas phase, electrolysis and plasma. Theoretical foundations of mechanical alloying processes. Organization and course of the process of mechanical alloying. Influence of reagents controlling the process. Technology of foundry alloys. Obtaining sintered materials and alloys.	5									V
78	Technology of roasting and smelting processes	Theoretical knowledge of basic pyrometallurgical processes; theoretical knowledge of the processes of roasting sulfides, metal oxides: oxidizing, sulfiding, sulfating, chlorinating, etc.; theoretical knowledge of melting processes; practical skills in conducting thermodynamic analysis of firing and melting processes, practical skills in performing technological calculations of firing and melting processes.	5									V
79	Dehydration and dust collection	The discipline studies the theoretical foundations of the processes of dehydration and dust collection, the design and principle of operation of apparatuses used for drainage, centrifugation, thickening, filtering, drying and dust collection. Methods for the selection and calculation of the main auxiliary equipment and dehydration schemes are considered.	5									V
80	Design of concentrating plants	The discipline studies general information about the design and design of mining and metallurgical enterprises, initial data for design, selection and justification of quality indicators of enrichment and productivity of factories and individual workshops. Selection and calculation of technological and water-slurry enrichment schemes, selection and calculation of the main and auxiliary equipment. Organization of design of buildings and structures, general principles of equipment layout. Repair, storage and tailing facilities, master plan. CAD elements in the design of processing plants.	5									V

81	Modeling of metallurgical processes	The concept of models and modeling, systems and their characteristics. Theories and similarity criterion for modeling processes. Identification methods. Methods for developing information databases. Visualization and animation of models.	5									V
82	Basics of designing metallurgical production	General principles of investment and integrated technological design, characterization of modern metallurgical shops, industries, enterprises as design objects in their classical, probabilistic-statistical and cenological visions, project development methodology at the initial pre-design, design and post-project stages, characteristics and layout principles of all major technological stages in ferrous and non-ferrous metallurgy	5									V
83	Study of metallurgical systems	The current state and development of physical and chemical methods for the study of metallurgical systems and processes; methods for measuring temperatures, viscosity, density, electrical conductivity and surface tension of melts, measuring the vapor pressure of metals and their compounds, methods for monitoring the quality of metal products; fundamentals of thermodynamic and kinetic analysis of pyrometallurgical and hydrometallurgical processes	5									V
84	Technology of refractory and heat-insulating materials	Classification of refractory materials. raw material to receive. Refractory products. Principal scheme of 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, fireclay, high alumina, magnesia-based, and others).	5									V
85	Digitalization of mining and processing and metallurgical plants	The questions of the theory of building digital systems for various levels of production management in the mining and processing and metallurgical industries are outlined. The analysis of the structure, functional and supporting parts of digitalization is given, the methodological foundations for building digital technologies are highlighted. Particular attention is paid to the role of digital technologies in improving the economic management mechanism in the mining and processing and metallurgical industries, as well as building its information support. Digital technologies will optimize processes while reducing the risk of injury to people working in hazardous areas. Complex mining tasks (mine planning, geological modeling, process control and maintenance) can be managed by intelligent analytical software packages and monitored in an	5									V

		integrated way, allowing real-time decisions to be made taking into account the entire mining process. industries.										
86	Fundamentals of scientific research in ore dressing	The discipline studies the problems of organizing and staging research work, choosing a topic for scientific work, stages and content of research work, principles for selecting information on the topic of scientific research, planning and setting up an experiment, requirements for publication materials, registration of patent documentation, presentation of scientific results and a research report. Acquaintance with the biography of scientists of Kazakhstan and the CIS, the role of scientific research in the formation and development of the enrichment industry.	5								V

4.4. Information about modules/disciplines

№	Name of the discipline	Brief description of the discipline (30-50 words)	Amount of credits	Formed competencies (codes)
Cycle of general education disciplines University component				
1	Foreign language	After determining the level (according to the results of diagnostic testing or IELTS results), students are divided into groups and disciplines. The name of the discipline corresponds to the level of English proficiency. When moving from level to level, prerequisites and postrequisites of disciplines are observed.	10	KK3, KK7, KK9
2	Kazakh (Russian) language	The socio-political, socio-cultural spheres of communication and functional styles of the modern Kazakh (Russian) language are considered. The course covers the specifics of the scientific style in order to develop and activate professional communication skills and abilities of students. The course allows students to practically master the basics of the scientific style and develop the ability to produce a structural and semantic analysis of the text.	10	KK3, KK7, KK9
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. Acquaintance with the natural-scientific foundations of physical education, possession of modern health technologies, the main methods of independent physical education and sports. And also within the framework of the course, the student will master the rules of refereeing in all sports.	8	KK3, KK7, KK9
4	Information and Communication Technologies (in English)	The task of studying the discipline is to acquire theoretical knowledge about information processes, about new information technologies, local and global computer networks, methods of information protection; obtaining skills in the use of text editors and spreadsheet processors; creation of databases and various categories of application programs.	5	KK4, KK5
5	Modern history of Kazakhstan	The course studies historical events, phenomena, facts, processes that took place on the territory of Kazakhstan from ancient times to the present day.	5	KK3, KK7, KK8, KK9
6	Philosophy	Philosophy forms and develops critical and creative thinking, worldview and culture, provides knowledge about the most general and fundamental problems of being and endows them with a methodology for solving various theoretical practical issues.	5	KK4, KK5
7	Module of socio-political knowledge (sociology,	Formation of theoretical knowledge about society as an integral system, its structural	3	KK4, KK5

	political science)	elements, connections and relationships between them, the features of their functioning and development, as well as the political socialization of students of a technical university, ensuring the political aspect of training a highly qualified specialist on the basis of modern world and domestic political thought.		
8	Module of socio-political knowledge (culturology, psychology)	It is designed to acquaint students with the cultural achievements of mankind, to understand and assimilate the basic forms and universal patterns of the formation and development of culture, to develop their desire and skills to independently comprehend the entire wealth of values of world culture for self-improvement and professional growth.	3	KK1, KK3, KK8, KK9
Cycle of general education disciplines Selectable Component				
9	Fundamentals of anti-corruption culture	It reveals the general patterns of the emergence, development and functioning of an anti-corruption culture, and other social phenomena and processes organically related to them.	5	KK1, KK3, KK8, KK9
10	Fundamentals of Entrepreneurship and Leadership	The discipline is aimed at revealing the content of entrepreneurial activity, career stages, qualities, competencies and responsibilities of a modern entrepreneur, as well as theoretical and practical business planning and economic examination of business ideas. They will develop their leadership and teamwork skills.	5	KK1, KK3, KK8, KK9
11	Ecology and life safety	Brief history of ecology. Ecology of individuals (Autecology); organism and environment. Ecology of populations (Demecology). Ecology of communities (Synecology). Ecosystems. Biosphere and its sustainability. Biomes. Ecological problems of the present. Life safety (BZhD) in the technosphere. Emergency situations of natural and technogenic nature. Organizational bases for the protection of the population from emergencies. Basic safety requirements for industrial equipment.	5	KK1, KK3, KK8, KK9
Cycle of basic disciplines University component				
12	Mathematics I	The course is based on the study of mathematical analysis in a volume that allows you to explore elementary functions and solve the simplest geometric, physical and other applied problems. The main attention is paid to differential and integral calculus. The sections of the course include differential calculus of functions of one variable, derivative and differentials, study of the behavior of functions, complex numbers, polynomials.	5	KK3, KK7, KK9
13	Mathematics II	The discipline is a continuation of Mathematics 1. The sections of the course	5	KK3, KK7, KK8, KK9

		include: elements of linear algebra and analytic geometry. Differential calculus of a function of several variables and its applications. Multiple integrals.		
14	Physics I	The course studies the basic physical phenomena and laws of classical and modern physics; methods of physical research; the influence of physics as a science on the development of technology; connection of physics with other sciences and its role in solving scientific and technical problems of the specialty.	5	KK3, KK7, KK9
15	Engineering and computer graphics	The course develops the following skills in students: depict all possible combinations of geometric shapes on a plane, conduct research and measure them, allowing for image transformations; create technical drawings, which are the main and reliable means of information that provide communication between the designer and the designer, technologist, builder. Introduces students to the basics of automated preparation of the graphic part of design documents in the AutoCAD environment.	5	KK3, KK7, KK9
16	General chemistry	The purpose of the discipline is to study the basic concepts and laws of chemistry; fundamental laws of chemical thermodynamics and kinetics; quantum-mechanical theory of the structure of the atom and chemical bonding. Solutions and their types, redox processes, coordination compounds: formation, stability and properties. Structure of matter and chemistry of elements.	5	KK3, KK7, KK9
17	Physical chemistry	To form in students: the ability to understand the physical and chemical essence of processes and use the basic laws of physical chemistry in complex production and technological activities. After mastering this discipline, the student must know: the laws of thermodynamics; basic equations of chemical thermodynamics; methods of thermodynamic description of chemical and phase equilibria in multicomponent systems; properties of solutions; fundamentals of electrochemistry; basic concepts, theories and laws of chemical kinetics and catalysis.	5	KK3, KK7, KK8, KK9
18	Technological mineralogy	General information about mineralogy. Formation of minerals in nature. Basic concepts about crystals. Properties of minerals and their classification. The properties of minerals used in the processing of various mineral raw materials to obtain metals have been studied. The concept of minerals and deposits. Mineral deposits of the Republic of Kazakhstan.	4	KK1, KK3, KK8, KK9
19	Fundamentals of mineral	The processes of preparation of mineral	6	KK4, KK5

	processing	raw materials for enrichment, the main regularities used in their implementation, the processes of separation of minerals based on the contrast of physical and physico-chemical properties, the laws of physics and chemistry underlying these processes, auxiliary processes implemented in the technologies of enrichment of solid minerals, designs of devices used in various stages of mineral processing technologies, wastewater treatment technologies and waste storage of processing plants, quality control of manufactured products, enrichment studies.		
20	Ore preparation processes and equipment	Ore preparation is widely used in the processing of ores of ferrous and non-ferrous metals, rare metal and gold-bearing raw materials, as well as non-metallic raw materials, building materials and other areas of the national economy of the Republic of Kazakhstan. This course studies in detail the technological processes of ore preparation and enrichment, the design of the equipment used, the methods for calculating and selecting the main and auxiliary equipment, the operation of crushing and grinding equipment.	5	KK1, KK3, KK8, KK9
21	Gravity enrichment methods	This course studies in detail: Theoretical foundations of gravity enrichment; Hydraulic and pneumatic classification processes and apparatuses; Enrichment in heavy environments; Enrichment with jigging; Enrichment in the flow of water flowing along an inclined surface; Pneumatic enrichment; Washing of ores.	5	KK4, KK5
22	General metallurgy	Cast iron and iron production: raw materials and their preparation; blast furnace design; domain process; equipment and operation of sections serving the blast furnace; performance indicators of blast furnaces; methods of non-domain (coke-free) production of iron. Steel production: general principles of steelmaking; converter steel production; open-hearth steel production; steel smelting in electric furnaces; ingots and steel casting; continuous casting of steel; modern technologies for producing high quality steel; out-of-furnace processing of steel; complex technologies for out-of-furnace processing of cast iron and steel; steel production in continuous units; melting processes. Production of non-ferrous metals: copper metallurgy; nickel metallurgy; aluminum metallurgy; receiving other non-ferrous metals.	5	KK4, KK5, KK6
23	Theory of metallurgical processes I	Theory of pyro-, hydro- and electrometallurgical processes: basic laws, kinetics and thermodynamics of reactions, as well as properties of metallurgical	5	KK4, KK5, KK6

		melts. Processes such as segregation, recrystallization, distillation, rectification, dissolution, extraction, ion exchange, cementation and precipitation of metals and oxides from solutions with gases, etc. are described.		
24	Theory of metallurgical processes II	Theory of segregation methods of metal refining, evaporation, sublimation, condensation and sublimation processes, properties of oxide and sulfide melts, thermodynamics and kinetics of metal oxidation, carbon and oxide reduction processes, physical and chemical foundations of sulfide processing. Thermodynamics and kinetics of leaching, extraction and sorption processes.	5	KK4, KK5, KK6
25	Metallurgy of heavy non-ferrous metals	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 methods of processing: roasting, melting, converting, fire refining, leaching, purification of solutions, electrolysis and their instrumentation. Methods for processing middlings and new technologies to increase the complexity of the use of heavy non-ferrous metals in metallurgy.	5	KK4, KK5, KK6
26	Metallurgy of noble metals	Properties and scope of noble metals and their compounds. Sources of raw materials and the history of the development 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 primary and placer ores and extraction of precious metals from them. Refining of precious metals. Hardware design of the main processes. Methods for the associated extraction of precious metals from middlings and wastes of metallurgical production. New technologies in the metallurgy of noble metals.	5	KK4, KK5, KK6
27	Metallurgical heat engineering	Technical thermodynamics. Introduction to metallurgical heat engineering. Heat generation due to the chemical energy of fuel and electricity. Basic provisions of the theory of heat transfer. Heat transfer by conduction. Heat transfer by convection. Heat transfer by radiation. Mechanics of liquids and gases. Fundamentals of the theory of similarity and modeling. Fundamentals of the general theory of furnaces. Thermal work and design of kilns and kilns. Melting and foundry furnaces. Refractory materials.	5	KK1, KK2, KK7

		Energy equipment. Use of secondary energy resources.		
28	Thermal power engineering of metallurgical processes	Basic concepts and definitions of the working fluid and its main parameters, analysis of the fundamental laws of thermodynamics, thermodynamic processes, differential equations of thermodynamics, outflow and throttling of gases and vapors. The mutual transformation of heat into work, the relationship between thermal, mechanical and chemical processes that take place in thermal and cooling mechanisms. Heat generation due to the chemical energy of fuel and electricity. Basic provisions of the theory of heat transfer.	4	KK1, KK2, KK7
29	Metallurgical Engineering (in English)	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 metal melts. Fundamentals of the interaction of metallic and oxide phases. Kinetics of processes. Preparation of raw materials for the metallurgical process. Classification of metals. Metallurgy of ferrous metals. Manufacture of iron and steel. Metallurgy of non-ferrous metals. Hydrometallurgy. Pyrometallurgy. Metallurgical calculations	5	KK1, KK2, KK7
Basic disciplines Selectable Component				
30	Theory and technology of steelmaking processes	Prospects for the development of steelmaking production. The concept of steel, the classification of steel according to purpose, quality, composition, behavior in molds, production method. Steel marking. General scheme of production. Steel deoxidation methods, advantages and disadvantages. Features of the smelting of alloyed steels. Influence of alloying elements on the properties of steel. direct doping. Development of converter steel production. Steel production in continuous steelmaking plants.	5	KK1, KK3, KK8, KK9
31	Powder metallurgy	Classification of methods for obtaining powder materials. Mechanical methods for obtaining powder materials. Reducers used in powder metallurgy. Obtaining powders by methods of reduction of chemical compounds of metals. Examples of obtaining powder metals by methods of high-temperature reduction of chemical compounds. Obtaining powder recovery materials from solutions.	5	KK1, KK3, KK8, KK9
32	Magnetic and special enrichment methods	Magnetic properties of minerals, Theory of magnetic fields of magnetic separators. Classification of magnetic separators. The structure and dynamics of movement of mineral particles in them. The practice of using magnetic separators and auxiliary	5	KK4, KK5

		devices. Obtaining artificial concentrates from mineral raw materials that cannot be enriched. Combined processes of processing of mineral raw materials (combination of enrichment processes and metallurgical operations). Fine-tuning of substandard concentrates.		
33	Theory and technology of preparation of technogenic and secondary raw materials of ferrous and non-ferrous metallurgy for metallurgical processing	Scrap metal as a man-made raw material for metallurgical enterprises. Material and energy saving in the recycling of scrap metal. Technologies for the preparation of ferrous and non-ferrous metals used in metallurgical enterprises. The concept of elements - "vagants". Their influence on the quality of products from ferrous metals and metallurgical technologies. Circulation of "vagant" in the technological cycle of metallurgical enterprises. Modern standards of the EU, USA and Japan, taking into account the presence of "vagant" in metallurgical raw materials. Preparation of technogenic energy resources. Plastics, MSW, used oils and lubricants. Methods for the environmentally safe use of technogenic energy resources in metallurgical production.	5	KK4, KK5
34	Experimental foundations in metallurgy	Formation of knowledge, skills and abilities in the field of metallurgical experiment technology and their application in professional activities. Objectives of the course: to convey basic theoretical knowledge on the course "Metallurgical Laboratory"; to teach how to solve typical tasks for the implementation of a metallurgical experiment; to form students' skills of practical work in the laboratory for research of metallurgical processes and systems.	5	KK4, KK5, KK6
35	Flotation reagents in MP	Basic theories of flotation in its current state. The methods for studying the action of flotation reagents and the mechanism of the flotation process are described in detail, as well as the processing of the results obtained. The fundamentals of the theory and practice of using flotation reagents in the flotation of non-ferrous ores and accompanying rare metals are outlined. The structure and composition, physical and chemical properties of the reagents are described.	5	KK4, KK5, KK6
36	Special electrometallurgy	Basic laws of theoretical and applied electrochemistry. Technological foundations of electrorefining and electrodeposition of non-ferrous metals in aqueous and molten media, electroplating of the surface of products, as well as obtaining metal powders under electrolysis conditions.	5	KK1, KK2, KK7
37	Corrosion and protection of metals	Classification of corrosion processes. Films on metals. Mechanism of diffusion	5	KK1, KK2, KK7

		in protective films. electrochemical corrosion. Thermodynamics of electrochemical corrosion. Secondary processes and products of electrochemical. Classification of protection methods. Methods of protection against chemical and electrochemical corrosion.		
38	Processes and equipment for enrichment production	The course deals with the theoretical foundations of the processes, describes the design of typical devices and methods for their calculation, highlights the issues of servicing the devices.	5	KK1, KK2, KK7
39	Autogenous processes in metallurgy	Issues of theory and practice of modern autogenous processes for the processing of non-ferrous metal raw materials (KIVCET, PZhV, Outokumpu-Ou, QSL, Ausmelt, Isasmelt, etc.). Technological schemes of production, design and principle of operation of metallurgical units, the main technical and economic indicators of processes.	5	KK1, KK2, KK7
40	Composite materials technology	Definition and classification of composite materials. Basic concepts of the mechanics of composite materials: modulus of elasticity, strength, destruction, chemical, thermal and mechanical stability. Components used in the production of composite materials: matrix and reinforcing materials and their production.	6	KK1, KK2, KK8, KK9
41	Auxiliary facilities in the MP	The discipline studies the theoretical foundations of the processes of dehydration and dust collection, the design and principle of operation of apparatuses used for drainage, centrifugation, thickening, filtering, drying and dust collection. Methods for the selection and calculation of the main auxiliary equipment and dehydration schemes are considered. The relationship of auxiliary facilities with the technological processes of enrichment. Methods of calculations and selection of auxiliary equipment.	6	KK1, KK2, KK8, KK9
Cycle of major disciplines University component				
42	Metallurgy of ferrous metals	Raw material base of ferrous metallurgy. Basic minerals, ore quality, supply of iron, manganese, chromium ores to metallurgical enterprises. The main deposits of coal and flux-forming. Preparation of raw materials for melting. Obtaining coke, coke battery. Preparation of ores for smelting. Crushing, separation, enrichment of ores. Production of sinter and pellets. Processes occurring during sintering of sinter and firing of pellets. Cast iron smelting.	5	KK1, KK2, KK8, KK9
43	Metallurgy of light metals	Methods for opening ores, concentrates, middlings containing light metals. Processing of compounds of light metals	5	KK1, KK2, KK8, KK9

		by hydro- and pyrometallurgical methods of concentration, separation in order to obtain pure compounds and their further processing by methods of rectification, electrolysis, thermal processes.		
44	Metallurgy of secondary raw materials	The course "Metallurgy of secondary raw materials" examines the main processes in hydrometallurgy. Theoretical bases and technological schemes of leaching processes. Non-oxidizing and oxidizing leaching of metallurgical raw materials. Hydro - and electrometallurgical processing of sulfide materials. Theory and practice of extraction and sorption processes. Fundamentals of precipitation processes of poorly soluble compounds. Thermodynamics of electrochemical processes in the processing of metallurgical raw materials and the production of metals.	6	KK1, KK2, KK8, KK9
45	Flotation enrichment methods	The physical and chemical foundations of the flotation process are considered. Reasons for the appearance of free energy at interphase boundaries. The use of flotation reagents to control the change in energy at the phase boundaries. Adsorption processes at phase separations. Classification of flotation reagents and their role in flotation. The mechanism of action of the reagents. Flotation machines, features of their designs and applications. Flotation enrichment schemes. Brief information about the use of reagents in the flotation enrichment of various types of ores.	4	KK1, KK2, KK7
Cycle of major disciplines Selectable Component				
46	Processes of processing of technogenic wastes	The course "Processes of processing of technogenic wastes" considers the main ways of processing technogenic raw materials of some heavy non-ferrous, noble, light and rare metals. In particular, the main sources of waste generation, their classification and characteristics are 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 man-made waste, basic technological schemes and instrumentation for the production of basic heavy, rare, light and noble metals from lumpy waste, slag, dust, sludge, industrial solutions and a number of other man-made waste are covered.	5	KK1, KK2, KK7
47	Receipt, quality and certification of by-products during recycling	Peculiarities of metallurgical processes during melting "to slag". Blast-furnace melting with the use of technogenic materials and obtaining slag of a given composition. Regularities of mass transfer between metal and slag. Formation of	5	KK1, KK2, KK7

		neutral compositions of elements - "vagants". By-products of coke production. The use of finely dispersed carbon-containing man-made materials in the production of coke. Slag processing. Vitrification of potentially hazardous and toxic compounds. Obtaining metallurgical gases of a given composition using technogenic raw materials. Quality and certification of by-products.		
48	Consumer properties of metallurgical products	Classification of metallurgical products, quality control methods, requirements for consumer properties of metallurgical products, fixed in the standardization and certification system, specific consumer properties of metallurgical products obtained from secondary and technogenic raw materials. Methods and technologies used for the process of management and quality control of metallurgical products obtained from secondary and technogenic raw materials	5	KK1, KK2, KK7
49	Geotechnology in metallurgy	Geochemical processes in the earth's crust. Formation of minerals and deposits of non-ferrous and ferrous metals. Methods of geotechnology. Possibilities of extraction of metals by geotechnological methods. Choice of geotechnology method of metal mining in accordance with the nature and condition of the ore reserves. Underground, borehole and group leaching. Influence of the nature of the reagent on the extraction of metals.	5	KK1, KK2, KK7
50	Special and combined enrichment methods	Special methods of enrichment, ore sorting of mineral raw materials (manual and automatic) to improve the quality of raw materials and extract valuable minerals. Mineral raw materials that cannot be enriched and methods for their processing using combined processes (enrichment and metallurgy). Refinement of concentrates that are conditioned in terms of the base metal, but defective in terms of impurities. Processing of collective concentrates obtained by enrichment methods using pyro- and hydrometallurgical operations.	5	KK1, KK2, KK7
51	Geotechnological enrichment methods	Methods of geotechnological extraction of minerals, in order to determine the possibility of transferring the extracted useful components into a mobile state. The issues of physical and chemical foundations of geotechnological processes are considered. The schemes of geotechnological processing of uranium, gold, manganese, iron ores and non-metallic minerals are studied, and the processes of processing products of geotechnologies are considered.	5	KK1, KK2, KK7
52	Alloys of non-ferrous and ferrous metals	The main processes of melting alloys of non-ferrous and ferrous metals include issues of a theoretical, technological and	4	KK1, KK2, KK7

		constructive nature in the field of traditional and new metallurgy processes. Acquisition of competencies in the analysis of metal production technologies, the development of technological schemes and designs of metallurgical units and the conduct of technological calculations.		
53	Design of metallurgical units in ferrous metallurgy	The main advanced designs of melting, heating and thermal furnaces; methods of calculation, design of units and optimization of their technological parameters.	4	KK1, KK2, KK7
54	Processing of uranium and rare metal raw materials of Kazakhstan	Prospects for the use of atomic energy for peaceful purposes, world reserves of uranium, its mineral sources. Properties of uranium, forms of its presence in aqueous solutions. Methods for preparing ores for hydrometallurgical processing. Radiometric and mechanical enrichment of uranium ores, their acid and carbonate leaching. Extraction of uranium from poor and off-balance ores. Chemistry of rare earth elements. Methods for extracting REE from various types of mineral raw materials.	4	KK1, KK2, KK7
55	Theory and practice of metal refining	Methods for the separation, concentration and purification of metals (extraction, ion exchange, electrolysis and electrodialysis, crystallization from solutions and melts, purification and separation of metals by vacuum and gas-phase metallurgy, etc.), instrumentation of technological processes, engineering methods for calculating the purification of metals.	4	KK1, KK2, KK7
56	Testing and control of enrichment processes	Basic concepts about the process of testing minerals, products of their enrichment, control of technological processes at processing plants. List of controlled parameters. Methods and technical means of sampling from immobile materials and from moving masses. Determination of the minimum amount of sample from the mass of the batch being tested. Minimum mass of incremental sample. The minimum mass of a sample for analysis: chemical, granulometric, fractional. Sample preparation. Control of enrichment processes. Technological and commodity balance. Organization of testing and control.	4	KK1, KK2, KK8, KK9
57	Study of ores for washability	Methods for taking technological samples, preparing them for analysis for washability, drawing up sample cutting schemes, the material and mineralogical composition of ore using various methods of analysis, the use of experiment planning, the methodology for conducting schematic experiments, the procedure for conducting semi-industrial and industrial tests, the methodology for compiling research reports.	4	KK1, KK2, KK8, KK9

58	Processes and devices in ferrous metallurgy	The discipline "processes and apparatus in ferrous metallurgy" studies existing and new processes and apparatus for the production of ferrous metals and their chemical compounds.	6	KK1, KK2, KK8, KK9
59	Processes and devices in non-ferrous metallurgy	Theoretical regularities of hydromechanical, thermal and mass transfer processes in metallurgy; hardware design of these processes; production of analysis of technological processes and necessary calculations.	6	KK1, KK2, KK8, KK9
60	Metallurgical furnaces	The main types of fuel and its combustion, classification and general characteristics of the operation of furnaces, materials used in furnace building, elements and design of a number of furnaces used in non-ferrous and ferrous metallurgy.	6	KK1, KK2, KK8, KK9
61	Types of coatings on metals and processes for their production	Formation of knowledge, skills and abilities in the field of theory and technology of obtaining coatings on metals. Course objectives: to convey basic theoretical knowledge on the course "Types of coatings on metals and processes for their production"; to teach how to solve typical problems on the processes of obtaining coatings on metals and methods for controlling their quality; to form students' analytical thinking skills in the field of coating technology, depending on the raw materials used and methods for obtaining coatings on metals.	6	KK1, KK2, KK8, KK9
62	Enrichment of gold and uranium ores	Technology for processing gold ores using enrichment and metallurgical operations. Refining. Associated gold recovery during the processing of copper and zinc concentrates. Technologies for processing secondary raw materials containing precious metals. Material composition of uranium ores. Technology for processing uranium ores. Refining. Associated extraction of rare metals during the processing of uranium raw materials.	6	KK1, KK2, KK8, KK9
63	Modeling of enrichment processes	Methods for compiling models of enrichment processes. Obtaining high technological indicators by performing experiments using mathematical planning methods. Compilation of planning matrices, evaluation of the dispersion of experiments, determination of the adequacy of the resulting model and its application. General questions of modeling production systems. Application of theoretical relationships and statistical methods for the mathematical description of enrichment processes.	6	KK1, KK2, KK8, KK9
64	Dust collection and gas cleaning in non-ferrous metallurgy	Processes occurring in various gas cleaning devices, design of dust collectors (cyclones, filters, scrubbers, etc.), conditions and features of their operation, as well as methods for their calculation. The advantages and disadvantages of each dust collecting device are considered, an	5	KK1, KK2, KK8, KK9

		analysis of their application areas is given. The schemes used to clean gases from dust and harmful gaseous components in various workshops of ferrous and non-ferrous metallurgy enterprises are being studied.		
65	Metallurgy of lead and zinc	Technological schemes and physical and 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 instrumentation of the production processes of these metals are covered. The processes of preparation of raw materials for metallurgical processing, processes of reduction smelting in shaft furnaces, processes of roasting, leaching, purification of solutions from impurities, fire refining, electrolytic refining in aqueous media with the production of commercial lead and zinc are studied. New technologies in the production of lead and zinc are considered.	5	KK1, KK2, KK8, KK9
66	Heat and mass transfer of metallurgical processes	General information about mass transfer processes, basic concepts and definitions. Methods for expressing phase compositions. balance between phases. Mass transfer equation. Material balances of mass transfer processes. The mechanism of mass transfer processes. The driving force of mass transfer processes. The rate of mass transfer processes. General information about heat exchange processes, basic concepts and definitions. Heat transfer surface, stationary and non-stationary heat transfer processes, methods of heat transfer. Thermal balances. Heat transfer equations.	5	KK1, KK2, KK8
67	Processes and apparatuses of powder metallurgy	Production of metal powders by mechanical methods. Obtaining iron powders by reduction methods. Production of tungsten and molybdenum powders by reduction methods. Carbonyl method for obtaining metal powders.	5	KK1, KK2, KK8
68	Enrichment of polymetallic ores	Ores of non-ferrous metals are a complex raw material and a source of obtaining not only non-ferrous, but also rare, noble, rare earth metals, sulfur, barite, fluorite, quartz, feldspars and other elements, and minerals that are essential for various sectors of the national economy of the Republic of Kazakhstan. The course is devoted to the study of the variety of technological schemes, reagent regimes and methods for the enrichment of polymetallic ores.	5	KK1, KK2, KK8
69	Enrichment of ores of rare metals	Types and deposits of ores of rare metals. Their technical characteristics and classification by chemical and mineralogical composition. Preliminary	5	KK1, KK2, KK8

		enrichment of ores and placers of rare metals. Ore preparation operations in the processing of ores and placers of rare metals. Technology of enrichment and integrated use of the main types of ores and placers (tungsten and tungsten-molybdenum, tin and tin-polymetallic ores, titanium-zirconium ores and placers, tantalum-niobium ores and placers, etc.)		
70	Ferroalloy metallurgy	Prospects for the development of ferroalloy metallurgy. The essence and classification of electrical methods of heating and melting. The main groups of ferroalloys smelted in ferroalloy shops.	5	KK1, KK2, KK8
71	Metallurgy of copper and nickel	Theoretical foundations of traditional and modern technological processes for the production of copper and nickel. Designs of metallurgical units and principles of their work. Regime parameters and indicators of processes.	5	KK1, KK2, KK8
72	Converting metallurgy and product design	The course "Current metallurgy and product design" considers the processes and technologies of the 2nd stage - refining of ferrous metals, production of steel and alloys, methods of processing scrap metal; processes and technologies of the 3rd redistribution - processing of metals by pressure in order to obtain metal products of a given design; processes and technologies of the 4th redistribution - additional processing of rolled products; production of hardware; processing of pig slags, as well as modern design methods using 3D product modeling.	5	KK1, KK2, KK8
73	Enrichment of mining-chemical and non-metallic raw materials	The discipline deals with the processing of mining and chemical raw materials, the equipment used, the principles for choosing processing schemes and evaluating technical and economic indicators, analyzing the material and mineralogical composition of the ore to choose the most effective technological scheme for enrichment. General information about mining and chemical raw materials and raw material base is given. Consumer requirements for enrichment products. The current state in the field of enrichment and processing, the prospects for further development of this industry.	5	KK1, KK2, KK8
74	Enrichment of ores of ferrous metals	The material composition of ore raw materials. Theoretical foundations and features of the enrichment of various ores of ferrous metals. Principles and conditions for the separation of ore minerals from intergrowths with non-metallic minerals, dressing of ores and its determination. Classification of methods and processes of ore beneficiation based on separating forces. Schemes and apparatus for enrichment of magnetite, titanomagnetite and other ores of complex	5	KK1, KK2, KK8

		composition, oxidation of iron ores and quartzites, brown iron ore, manganese and chromium ores, carbonate iron and manganese ores. Experience in the work of factories for the enrichment of ferrous metal ores. Ways of integrated use of mineral raw materials of ferrous metals.		
75	Foundry production of metals and alloys	The properties of the most widely used metals and casting alloys are discussed, the conditions and methods for preparing alloys determined by these properties are discussed, the basics of filling a casting mold with a melt are outlined, the regularities of crystallization of alloys under real conditions are considered, the processes of solidification of cast billets and their effect on crystallization and properties of alloys in cast blanks.	5	KK1, KK2, KK8
76	Metallurgy of radioactive and related metals	Issues of a theoretical and applied nature concerning the processing of raw materials containing radioactive elements, as well as the technology for the production of pure radioactive and associated metals, in particular uranium and RMZ.	5	KK1, KK2, KK9
77	Production of special purpose alloys	Features of technologies for obtaining pure refractory metals. Trends in the development of metallurgy of refractory metals in the XXI century. Prospects for the use of refractory metals. Preparation of alloys based on refractory metals by direct synthesis and reduction methods. Obtaining alloys based on refractory metals by the methods of deposition from the gas phase, electrolysis and plasma. Theoretical foundations of mechanical alloying processes. Organization and course of the process of mechanical alloying. Influence of reagents controlling the process. Technology of foundry alloys. Obtaining sintered materials and alloys.	5	KK1, KK2, KK9
78	Technology of roasting and smelting processes	Theoretical knowledge of basic pyrometallurgical processes; theoretical knowledge of the processes of roasting sulfides, metal oxides: oxidizing, sulfiding, sulfating, chlorinating, etc.; theoretical knowledge of melting processes; practical skills in conducting thermodynamic analysis of firing and melting processes, practical skills in performing technological calculations of firing and melting processes.	5	KK1, KK2, KK9
79	Dehydration and dust collection	The discipline studies the theoretical foundations of the processes of dehydration and dust collection, the design and principle of operation of apparatuses used for drainage, centrifugation, thickening, filtering, drying and dust collection. Methods for the selection and calculation of the main auxiliary equipment and dehydration	5	KK1, KK2, KK9

		schemes are considered.		
80	Design of concentrating plants	The discipline studies general information about the design and design of mining and metallurgical enterprises, initial data for design, selection and justification of quality indicators of enrichment and productivity of factories and individual workshops. Selection and calculation of technological and water-slurry enrichment schemes, selection and calculation of the main and auxiliary equipment. Organization of design of buildings and structures, general principles of equipment layout. Repair, storage and tailing facilities, master plan. CAD elements in the design of processing plants.	5	KK1, KK2, KK9
81	Modeling of metallurgical processes	The concept of models and modeling, systems and their characteristics. Theories and similarity criterion for modeling processes. Identification methods. Methods for developing information databases. Visualization and animation of models.	5	KK1, KK2, KK9
82	Basics of designing metallurgical production	General principles of investment and integrated technological design, characterization of modern metallurgical shops, industries, enterprises as design objects in their classical, probabilistic-statistical and cenological visions, project development methodology at the initial pre-design, design and post-project stages, characteristics and layout principles of all major technological stages in ferrous and non-ferrous metallurgy	5	KK1, KK2, KK9
83	Study of metallurgical systems	The current state and development of physical and chemical methods for the study of metallurgical systems and processes; methods for measuring temperatures, viscosity, density, electrical conductivity and surface tension of melts, measuring the vapor pressure of metals and their compounds, methods for monitoring the quality of metal products; fundamentals of thermodynamic and kinetic analysis of pyrometallurgical and hydrometallurgical processes	5	KK1, KK2, KK9
84	Technology of refractory and heat-insulating materials	Classification of refractory materials. raw material to receive. Refractory products. Principal scheme of 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, fireclay, high alumina, magnesia-based, and others).	5	KK1, KK2, KK9

85	Digitalization of mining and processing and metallurgical plants	The questions of the theory of building digital systems for various levels of production management in the mining and processing and metallurgical industries are outlined. The analysis of the structure, functional and supporting parts of digitalization is given, the methodological foundations for building digital technologies are highlighted. Particular attention is paid to the role of digital technologies in improving the economic management mechanism in the mining and processing and metallurgical industries, as well as building its information support. Digital technologies will optimize processes while reducing the risk of injury to people working in hazardous areas. Complex mining tasks (mine planning, geological modeling, process control and maintenance) can be managed by intelligent analytical software packages and monitored in an integrated way, allowing real-time decisions to be made taking into account the entire mining process. industries.	5	KK1, KK2, KK9
86	Fundamentals of scientific research in ore dressing	The discipline studies the problems of organizing and staging research work, choosing a topic for scientific work, stages and content of research work, principles for selecting information on the topic of scientific research, planning and setting up an experiment, requirements for publication materials, registration of patent documentation, presentation of scientific results and a research report. Acquaintance with the biography of scientists of Kazakhstan and the CIS, the role of scientific research in the formation and development of the enrichment industry.	5	KK1, KK2, KK9

5 Curriculum of the educational program

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

SATBAYEV UNIVERSITY

APPROVED
Director of the MaMMnamed after O.A. Baikonurov
K.B. Ryabkin
«20» 12 2022 y.

ELECTIVE DISCIPLINES of the educational program for recruitment for the 2023-2024 academic year
Educational program 6B07203 - "Metallurgy and mineral processing"
Group of educational programs B071 - "Mining and extraction of minerals"

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

Year of study	Elective code according to the curriculum	Discipline code	Name of disciplines	Semester	Cycle	Total amount in credits	Total hours	classroom volume of leh/lab/pr	SIS (including TSIS) in hours
Module of basic training									
3	3201	MET513	Theory and technology of steelmaking processes	5	B	5	150	2/0/1	105
		MET599	Powder metallurgy					2/0/1	
		MET516	Magnetic and special enrichment methods					1/1/1	
	3202	MET515	Theory and technology of preparation of technogenic and secondary raw materials of ferrous and non-ferrous metallurgy for metallurgical processing	6	B	5	150	2/1/0	105
		MET609	Experimental Foundations in Metallurgy					2/1/0	
		MET517	Flotation reagents in mineral processing					2/1/0	
	3203	MET518	Special electrometallurgy	6	B	5	150	2/0/1	105
		MET610	Corrosion and protection of metals					2/1/0	
		MET521	Processes and devices of processing production					2/1/0	
4	4204	MET127	Autogenous processes in metallurgy	7	B	6	180	2/0/2	120
		MET122	Technology of composite materials					2/1/1	
		MET420	Auxiliary economy in mineral processing					2/0/2	
Module of professional activity									
3	3301	MET554	Processes of processing of technogenic waste	6	P	5	150	2/0/1	105
		MET555	Receive, the quality and certification of by-products in the process of recycling					2/0/1	
		MET590	Consumer properties of metallurgical products					2/0/1	
		MET591	Geotechnology in metallurgy					2/0/1	
		MET571	Special and combined methods of dressing					1/1/1	
		MET542	Geotechnological methods of enriching					1/1/1	
	3302	MET528	Alloys of non-ferrous and ferrous metals	6	P	4	120	2/0/1	75
		MET573	Design of metallurgical units in ferrous metallurgy					2/0/1	
		MET592	Processing of uranium and rare metal raw materials of Kazakhstan					2/0/1	
		MET617	Theory and practice of metal refining					2/1/0	
		MET560	Assay and control of concentrating processes					1/1/1	
		MET574	Ore beneficiation research					2/1/0	
4	4303	MET141	Processes and devices in the ferrous metallurgy	7	P	6	180	2/0/2	120
		MET140	Processes and devices in non-ferrous metallurgy					2/0/2	
		MET108	Metallurgical furnaces					2/1/1	
		MET489	Types of coatings on metals and their production processes					2/0/2	
		MET617	Enrichment of gold-bearing and uranium ores					2/0/2	
		MET156	Modeling of enrichment processes					2/1/1	
	4304	MET563	Dust collection and gas cleaning in non-ferrous metallurgy	7	P	5	150	2/0/1	105
		MET529	Metallurgy of lead and zinc					2/1/0	
		MET580	Heat and mass transfer of metallurgical processes					2/0/1	
		MET581	Processes and devices of powder metallurgy					2/0/1	
		MET531	Enrichment of polymetallic ores					1/1/1	
		MET532	Enrichment of rare metal ores					2/1/0	
	4305	MET533	Metallurgy of ferroalloys	8	P	5	150	2/0/1	105
		MET534	Metallurgy of copper and nickel					2/1/0	
		MET582	Advanced metallurgy and product design					2/0/1	
		MET536	Enrichment of mining and chemical and non-metallic raw materials					2/1/0	
		MET537	Concentration of ferrous metals ores					1/1/1	
	4306	MET538	Foundry production of metals and alloys	8	P	5	150	2/0/1	105
		MET539	Metallurgy of radioactive and related metals					2/0/1	
		MET584	Production of special alloys					2/0/1	
		MET585	Technology of firing and melting processes					2/0/1	
		MET541	Enrichment of ores of ferrous metals					1/1/1	
		MET564	Design of concentrating factory					2/1/0	
Module of "R&D"									
4	4307	MET558	Modeling of metallurgical processes	8	P	5	150	2/0/1	105
		MET575	Fundamentals of metallurgical production design					2/0/1	
		MET583	Metallurgical systems research					2/1/0	
		MET594	Technology of refractory and heat-insulating materials					2/0/1	
		MET576	Digitalization of mining and processing and metallurgical plants					2/1/0	
		MET572	Fundamentals of scientific research in ore dressing					2/1/0	

The number of credits in elective subjects for the entire period of study	
Cycles of disciplines	Credits
Cycle of basic disciplines (B)	21
Cycle of profile disciplines (P)	35
TOTAL:	56

Decision of the Scientific Council of the Mining and Metallurgical Institute named after O.A. Baikonurov. Protocol № 5 от «20» 12 2022 y.

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

Representative of the employers' council of the LLP "KAZ Minerals" U.K. Jetybaeva

MET504	Металлургия легких металлов	ПД, ВК	5	150	2/1/0	105	Э							5	
MET415	Металлургия вторичного сырья	ПД, ВК	6	180	2/1/1	120	Э							6	
	М-11. Модуль профессиональной деятельности по обогащению руд														
MET507	Флотационные методы обогащения	ПД, ВК	4	120	2/1/0	75	Э						4		
	М-12. Модуль профессиональной деятельности														
3301	Элективы	ПД, КВ	5	150	2/1/0*	105	Э						5		
3302	Элективы	ПД, КВ	4	120	2/1/0*	75	Э						4		
4303	Элективы	ПД, КВ	6	180	2/1/1*	120	Э							6	
4304	Элективы	ПД, КВ	5	150	2/1/0*	105	Э							5	
4305	Элективы	ПД, КВ	5	150	2/1/0*	105	Э								5
4306	Элективы	ПД, КВ	5	150	2/1/0*	105	Э								5
AAP143	Производственная практика I	ПД, ВК	2		0/0/2						2				
AAP183	Производственная практика II	ПД, ВК	3		0/0/3								3		
	М-13. Модуль "R&D"														
4307	Элективы	ПД, КВ	5	150	2/1/0*	105	Э								5
	М-14. Модуль итоговой аттестации														
ECA403	Подготовка и написание дипломной работы	ИА	6												6
ECA103	Защита дипломной работы (проекта)	ИА	6												6
	М-15. Модуль дополнительных видов обучения														
AAP500	Военная подготовка	ДВО	0												
	Итого по УНИВЕРСИТЕТУ:							31	29	28	32	29	31	33	27
								60		60		60		60	

Количество кредитов за весь период обучения					
Код цикла	**Циклы дисциплин**	**Кредиты**			
		обязательный компонент (ОК)	**вузовский компонент (ВК)**	**компонент по выбору (КВ)**	**Всего**
ООД	Цикл общеобразовательных дисциплин	51		5	56
БД	Цикл базовых дисциплин		81	31	112
ПД	Цикл профилирующих дисциплин		25	35	60
	Всего по теоретическому обучению:	*51*	*106*	*71*	*228*
ИА	Итоговая аттестация	12			12
	ИТОГО:	63	106	71	240

Решение Учёного совета КазНИТУ им. К.И. Сатпаева. Протокол № 13 **от** "28" 04 **20**22 **г.**

Решение Учебно-методического совета КазНИТУ им. К.И. Сатпаева. Протокол № 7 **от** "26" 04 **20**22 **г.**

Решение Ученого совета ГМИ им. О.А. Байконурова. Протокол № 5 **от** "20" 12 **20**21 **г.**

Проректор по академическим вопросам — **Б.А. Жаутиков**

Директор Горно-металлургического института — **К.Б. Рысбеков**

Заведующий кафедрой "Металлургия и обогащение полезных ископаемых" — **М.Б. Барменшинова**

Заведующий кафедрой "Металлургические процессы, теплотехника и технология специальных материалов" — **Т.А. Чепуштанова**

Вуз-партнер:
Вустерский политехнический институт (США) — **Б. Миура**

Представитель Совета работодателей от ТОО "Казахмыс" — **Е.А. Оспанов**

Представитель Совета работодателей от ТОО "KAZ Minerals" — **У.К. Джетыбаева**

6. Additional educational programs (Minor)

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

CHANGE REGISTRATION SHEET

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