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

EDUCATIONAL PROGRAM

6B07212 – Recycling in metallurgy

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:	B171 – Metallurgy
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 «6B07212 - Recycling in metallurgy» 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 «6B07212 - Recycling in metallurgy» 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	
Teaching staff:				
Baimbetov B.S.	c.t.s., docent	Professor of the Departament of MaMP	KazNITU named after K.I. Satpaeva	
Moldabayeva G.	c.t.s.	Associate Professor of the Departament 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	
Protsenko R.R.		Chief technologist	Kazferrostal LLP	
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 «6B07212 – Recycling in metallurgy» 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).

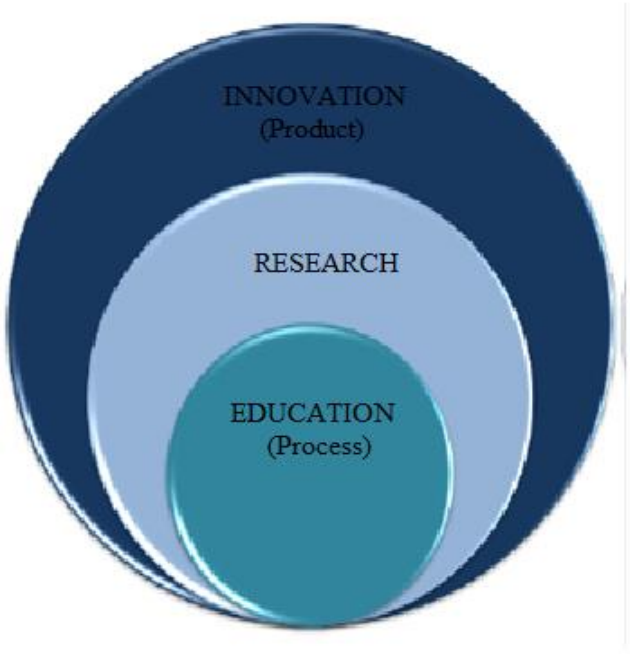

Figure 1 - The concept of scientific and educational programs

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 "6B07212 – Recycling in metallurgy" includes fundamental, natural science, general engineering and professional training of bachelors in the field of secondary metallurgy and recycling of industrial and industrial waste in accordance with the development of science and technology, as well as the changing needs of the mining and metallurgical industry. A distinctive feature of the program is that the program gives the graduate adaptability to the manufacturing sector, due to the content of 40% of general engineering disciplines in the educational program. The graduate receives a fundamental set of general engineering disciplines, as well as the maximum set of specialized disciplines.

The program provides an in-depth study of the theory of metallurgical processes, theory and technology of preparation of technogenic and secondary raw materials of ferrous and non-ferrous metallurgy for metallurgical conversion, metallurgical heat engineering, furnace theory, design of metallurgical aggregates, design of secondary metallurgy enterprises, physico-chemical analysis methods, recycling technology in ferrous and non-ferrous metals metallurgy, logistics of waste management. Graduates have knowledge of metallurgical technologies, including the stages of production and global recycling.

The mission of the educational program "6B07212 – Recycling in metallurgy": preparation of bachelors in the field of secondary metallurgy and

waste recycling, who know the methods of determining the quality of technogenic materials and secondary resources, methods of preparing technogenic and secondary raw materials of ferrous and non-ferrous metallurgy for metallurgical conversion, technologies of their use and processing by metallurgical methods, who have fundamental training in physics, mathematics, chemistry, physico-chemical fundamentals of technologies of metallurgical processing of metal-containing non-traditional raw materials, environmental and economic aspects of the production of secondary ferrous and non-ferrous metals. 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 factories and factories, conduct experimental research using information technology and mathematical modeling.

The field of professional activity. Specialists who have graduated from the bachelor's degree, perform production, technological and organizational work at industrial enterprises engaged in the processing of man-made and secondary raw materials, as well as conduct research work to determine the quality of man-made materials and secondary resources, assess the complex impact of metallurgical technologies on the state of processes in the biosphere, study the circulation of elements in the technosphere and the formation of man-made deposits on territories of industrial enterprises, the study of sustainable, environmentally safe industrial development on the example of metallurgy, the development of environmentally friendly technologies and equipment for the use and processing of man-made materials and secondary resources, forecasting the output of main and associated products and the amount of emissions into the environment, assessing the social consequences of engineering solutions.

Objects of professional activity. The objects of professional activity of graduates are processing plants, enterprises of ferrous and non-ferrous metallurgy, chemical, mining, chemical and machine-building industries where, in addition to the main products, various metal-containing wastes are formed, branch research and design institutes, factory laboratories, secondary vocational and higher educational institutions.

The subjects of professional activity are technological processes and devices for processing technogenic and secondary raw materials and the production of metal products with increased consumer properties from them; processes of formation of technogenic deposits; processes and devices for ensuring energy and resource conservation and environmental protection during metallurgical operations; automatic control systems of metallurgical production, methods of analysis and quality control of final products.

Types of economic activity: material and energy saving during scrap metal recycling; global elemental flows of metals in the technosphere; movement of secondary metallurgical materials at a full-cycle enterprise; methods of environmentally safe use of technogenic energy resources in metallurgical production; secondary raw materials of ferrous and non-ferrous metals and its preparation for metallurgical processing; pyro- and hydrometallurgical

technologies for processing secondary and technogenic raw materials ferrous and non-ferrous metals; hardware design for the production of secondary metals; auxiliary processes in the production of secondary metals; environmental and economic aspects of the production of secondary metals; methods and technological processes for the protection of the atmosphere and hydrosphere.

2. Purpose and objectives of the educational program

– practice-oriented training of competitive and in-demand specialists in the field of secondary metallurgy and recycling of industrial and industrial waste for the mining and metallurgical complex of the Republic of Kazakhstan, possessing professional and personal competencies that allow performing design, production and technological, scientific and technical, organizational and entrepreneurial activities at ferrous and non-ferrous metallurgy facilities.

– combining the efforts of the university and industrial enterprises to conduct 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 urban environment objects, the principles of sustainable development of urbanized territories and measures of their organizational and legal support with the provision of true interdisciplinary education in these areas;

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

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

– fundamentals of the development and implementation of fundamental and applied research and R&D in the field of geological exploration and mineral processing, mining and metallurgy using new technological achievements, new generation equipment and eco-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, an experimental base for the implementation of educational research, laboratory and coursework, production and pre-graduate practice;

– improving the level of educational and methodological work by creating new curricula, textbooks, teaching 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-tech innovative companies and other research centers;

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

– implementation of international cooperation in the field of 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;

– formation of theoretical and practical knowledge in technologies of processing of technogenic and secondary raw materials, knowledge in technologies of 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 extracting all known metals by processing man-made raw materials and using secondary resources. The graduate has the ability to analyze raw materials and apply the best method of extracting metals from man-made and secondary raw materials; apply pyro-, hydro-, electrometallurgy technologies; with his knowledge and skills can influence the reduction of waste and environmental pollution; influence optimal fuel consumption, the ability to perform the necessary technical, thermal, thermal, metallurgical calculations; to carry out the design of workshops and equipment of secondary metallurgy.

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

– technological metallurgy is an industry where metal parts are designed and the processes under 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 creating environmentally friendly production, with sufficiently complete use of production waste and subsequent restoration of renewable natural resources, reducing environmental pollution, ensuring the integrated use of raw materials, environmental protection, resource, energy conservation 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 work skills at enterprises for the processing of secondary and man-made raw materials and waste recycling.

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 your future profession. Have knowledge of the formation and development of the mining, metallurgical, machine-building, chemical industry of Kazakhstan and current 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.

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	B171 – Metallurgy
4	Name of the educational program	Recycling in metallurgy
5	Brief description of the educational program	The educational program "Recycling in Metallurgy" includes fundamental, natural science, general engineering and professional training of bachelors in the field of secondary metallurgy and recycling of industrial and industrial waste in accordance with the development of science and technology, as well as the changing needs of the mining and metallurgical industry.
6	Purpose of the EP	practice-oriented training of competitive and in-demand specialists in the field of secondary metallurgy and recycling of industrial and industrial waste for the mining and metallurgical complex of the Republic of Kazakhstan, possessing professional and personal competencies that allow performing design, production and technological, scientific and technical, organizational and entrepreneurial activities at ferrous and non-ferrous metallurgy facilities.
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. Moldabaeva G.Zh.

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	5		V						

		considered: the era of the Kazakh Khanate of the XV-XVIII 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	3			V					

		knowledge, practical skills and abilities, forming their professional 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	Metals and their compounds	The discipline studies the physical and chemical properties of metals, their compounds and alloys, their ores, deposits, distribution in	4	V							

		nature. The main methods of production, as well as the use of metals, their compounds and alloys in science and technology.										
17	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 atomic structure and chemical bonding. Solutions and their types, redox processes, coordination compounds: formation, stability and properties. The structure of matter and the chemistry of elements.	5		V							
18	General metallurgy	Production of cast iron and iron: raw materials and their preparation; the design of the blast furnace; the blast furnace process; equipment and operation of the sites servicing the blast furnace; the performance of blast furnaces; methods of non-domain (coke-free) iron production. Steel production: general fundamentals of steelmaking; converter steel production; open-hearth steel production; steel smelting in electric furnaces; ingots and casting of steel; continuous casting of steel; modern technologies for obtaining high-quality steel; non-furnace steel processing; complex technologies of non-furnace processing of cast iron and steel; production of steel in continuous units; remelting processes. Production of non-ferrous metals: metallurgy of copper; metallurgy of nickel; metallurgy of aluminum; production of other non-ferrous metals.	6			V						
19	Physical chemistry	To form students' ability to understand the physico-chemical essence of processes and use the basic laws of physical chemistry in complex production and technological activities. After mastering this discipline, the student should know: laws of thermodynamics; basic equations of chemical thermodynamics; methods of thermodynamic description of chemical and phase equilibria in multicomponent systems; properties of solutions; fundamentals of electrochemistry; basic concepts, theories and laws of chemical kinetics and catalysis.	5				V					
20	Fundamentals of the specialty in secondary metallurgy	Characteristics of secondary raw materials, structural features, forms of finding ferrous, non-ferrous and valuable metals. Modern methods of recycling secondary raw materials. New processes of additional extraction of non-ferrous and valuable metals from secondary raw materials. Selection and justification of methods for processing secondary raw materials, economic analysis and assessment of their possible processing. Waste-free, environmentally friendly technologies for processing secondary raw materials with complex extraction of valuable metals. SWOT analysis of existing and new recycling processes.	5			V						
21	Fundamentals of metal science	Structure of metals, atomic crystal structure and crystal lattices of	5				V					

		metals. Real structure of metal crystals, anisotropy of crystal properties. Defects in the crystal structure. Methods of studying the structure of metals and alloys. Processes of crystallization, elastic and plastic deformation, recrystallization and melting of metals. Mechanical properties and destruction of metals. Fundamentals of the kinetics of phase transformations in metal alloys, the structure of alloys. Diagrams of the state of double and triple metal systems.										
22	Theoretical foundations of metallurgical processes	Considers laws, theoretical provisions and conclusions on the structure and properties of metallic, oxide and sulfide systems: thermodynamics and kinetics of metallurgical processing of mineral and man-made raw materials, salt melts; liquation and distillation processes of production; methods of refining metals and the main directions of development of the theory and practice of extraction and refining of metals, taking into account the integrated use of raw materials and modern environmental requirements.	5					V			
23	Production of ferrous and non-ferrous metal alloys from waste	The main melting processes of non-ferrous and ferrous metal alloys include theoretical, technological and constructive issues in the field of traditional and new metallurgy processes. Acquisition of competencies in the analysis of metal production technologies, development of technological schemes and designs of metallurgical units and carrying out technological calculations.	5					V			
24	Design basics and machine parts	Basic requirements for machine parts and assemblies. Criteria for the operability of machine parts and methods of their evaluation. The concept of reliability and its main indicators. Basics of interchangeability. Mechanical transmissions and their classifications. Gears and their classification. Calculation of gear teeth for strength. Worm gears and their classification. Calculation of the strength of worm gears. Belt drives. Chain drives. Shafts and axles. Calculation of shafts for strength. Sliding and rolling bearings. Selection of rolling bearings. Types of connection. Calculation of the strength of the joint.	5					V			
25	Heat transfer and mass transfer in metallurgy	Heat power engineering of the agglomeration process. Heat power engineering of pellet firing. Heat power engineering of the blast furnace process. Heat exchange in a blast furnace. Heat transfer in a layer of lumpy materials. Factors affecting heat exchange processes. Thermal power engineering of converter production. The laws of mass and heat transfer. Mass and heat exchange in the baths of steelmaking units. Thermal balance of oxygen converter melting. Thermal losses of converters. The influence of technological parameters on the thermal operation of converters. Thermal power	5					V			

		engineering of electric steelmaking processes. Features of thermal operation of electric furnaces. Energy balances of electric furnaces. Features of thermal operation of ferroalloy furnaces.										
26	Design of secondary metallurgy enterprises	The design of metallurgical facilities and secondary metallurgy enterprises is a field of knowledge, concepts and ideas about the design of industrial facilities, which is carried out for the purpose of developing and/or drawing up design estimates for the construction of new and/or changes to existing metallurgical facilities during their expansion, modernization, technical re–equipment, reconstruction, restoration, overhaul, conservation and postutilization. The design of metallurgical facilities must be carried out taking into account the provisions of current legislation and state regulations in the field of architectural, urban planning and construction activities.	4					V			
27	Theory and technology of coke-free metallurgy	In this discipline, the scientific foundations of the processes of coke-free metallurgy are considered. Experimental and industrial technologies of metal production in rotary and shaft furnaces, in the fluidized bed and in the melt are described. The issues of production of the final metal from metallized raw materials, as well as the production of reducing gases are considered.	5						V			
		Cycle of basic disciplines **Elective component**										
28	Theory and technology of preparation of technogenic and secondary raw materials of ferrous and non-ferrous metallurgy for metallurgical processing	Scrap metal as technogenic raw materials 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 ferrous metal products and metallurgical technologies. Circulation of "vagants" in the technological cycle of metallurgical enterprises. Modern standards of the EU, USA and Japan, taking into account the presence of "vagants" in metallurgical raw materials. Preparation of technogenic energy resources. Plastics, solid waste, waste oils and lubricants. Methods of environmentally safe use of technogenic energy resources in metallurgical production.	5			V						
29	Recycling of fine industrial waste	The market of technogenic fine materials. Fine-dispersed solid household and industrial waste. Ash and slag waste. The concept of "shredding" technologies. Shredders. Composition and metallurgical characteristics of "shredding"-dusts. Meal, "heavy" and "light" fractions of shredding dust. Development and prospects of shredding technology. Compacting, briquetting, and caulking of fine technogenic materials. The role of ash and sludge accumulators in the	5			V						

		structure of a modern ferrous metallurgy enterprise. Sludge processing technologies: current state and prospects. Agglomeration and production of pellets using man-made and recycled materials.										
30	Wastewater treatment processes and devices	Properties and classification of waters according to their intended purpose. Issues of environmental safety of the hydrosphere. Fundamentals of water use in circulating and closed water supply systems of enterprises, as well as mechanical, chemical, physico-chemical, biochemical and thermal methods for removing soluble and insoluble contaminants from industrial wastewater. The main designs of devices, installations and structures for wastewater treatment from suspended and dissolved impurities. Constructive calculation of devices used in wastewater treatment: settling tanks, filters, flotators, adsorbers, electrolyzers, extractors, rectification plants, aerotanks and biofilters	5				V				
31	Physico-chemical methods of analysis	The main types of physico-chemical methods of analysis: spectral, electrochemical, chromatographic. The theoretical principles of the methods, the device and principles of operation of analytical equipment, methods of computer processing of experimental results are described.	5				V				
32	Continuous casting of steel	The importance of casting tasks for obtaining high-quality metal. Factors affecting the technical and economic indicators of production and quality of steel and electric fireplaces. A brief description of the main casting methods. The main physico-chemical, thermal and hydrodynamic problems of the studied discipline are considered. The concept of crystallization and solidification. Theory of casting of metals and alloys. Technologies of casting metals and alloys.	5					V			
33	Recycling technologies in the metallurgy of rare metals	Characteristics of waste containing rare metals. Recycling of waste of molybdenum, tungsten and niobium alloys using oxidative methods, electrochemical methods and halogenation methods. Extraction of rhenium from fine and lumpy waste of heat-resistant nickel alloys (ZHNS). Recycling of scrap of electronic equipment containing rare metals using pyro-, hydrometallurgical technologies. Recycling of waste of tungsten steels and hard alloys with the processing of lump waste (scale, chips, edge trimming after rolling, unused parts of tool plates, their fragments, defective products, etc.) and pulverized abrasive materials (dust from sharpening of carbide tools). Extraction of indium from secondary raw materials by the amalgam method. Recycling of gallium-containing waste of radioelectronics and electronics, processing of gallium arsenide waste by thermal dissociation, fusing with alkali in the presence of an	5					V			

		oxidizer, chlorination followed by rectification. Recycling of deactivated molybdenum-nickel, platinum-rhenium catalysts. Extraction of rhenium, molybdenum and tungsten from various solutions of hydrometallurgical processing of ore, technogenic and secondary raw materials. Extraction of germanium from dust formed during the processing of copper and zinc concentrates, from the dust of gas plants.										
34	Ecology of the metropolis	Assessment of the state of the natural environment under global changes; the main stages of the development of civilization and environmental crises characteristic of each of them; principles of respect for nature and sustainable development of civilization; methods of conducting field and laboratory environmental studies. Analysis of environmental processes and phenomena; formation of an ecological worldview based on the use of the provisions of the concept of sustainable development	5						V		
35	Theory and technology of steelmaking processes	Steel production is the second stage of a two-stage scheme for extracting iron from ores by converting cast iron and metal waste into steel. The essence of steelmaking processes consists in the oxidation of impurities of cast iron and steel scrap (carbon, silicon, manganese, phosphorus and others) with iron oxides of slag, iron ore, pure oxygen or air oxygen and bringing the composition of the liquid metal to the composition of grade steel, followed by its deoxidation and alloying.	5						V		
36	Dust collection and condensation in metallurgy	The course "Dust collection and condensation in metallurgy" aims to acquire students' knowledge and skills of working with equipment for dust collection and condensation in metallurgy. Students should know the theoretical and technological patterns of dust removal of particles processed during pyrometallurgical processes of materials depending on humidity, temperature, gas flow, size, as well as technological parameters during condensation of metal vapors and their compounds.	5						V		
37	Special electrometallurgy	Basic laws of theoretical and applied electrochemistry. Technological bases of electrofining and electrodeposition of non-ferrous metals in aqueous and molten media, electroplating the surface of products, as well as obtaining metal powders under electrolysis conditions.	5						V		
38	Processes of processing of technogenic and secondary raw materials	Processing of secondary and man-made raw materials of some heavy non-ferrous, noble, light and rare metals. The main sources of scrap and waste generation, their classification and characteristics. The design of the main and auxiliary equipment for the preparation of scrap and waste for metallurgical processing. Modern pyro- and	6							V	

		hydrometallurgical methods of processing secondary and technogenic raw materials, basic technological schemes and hardware design of the processes of production of basic heavy, rare, light and precious metals from lump waste, slag, dust, sludge, industrial solutions and a number of other secondary and technogenic waste.										
39	Technology of foundry production	A brief overview of the history of the technology of forming castings. The structure of the production of castings and the use of various technologies. The sequence of manufacturing a single casting mold. Schemes of technological processes for obtaining castings. Basic concepts and terms. The structure of the production of castings using various technologies. General technological schemes for the manufacture of castings. Types of foundry production.	6							V	
Cycle of profile disciplines University component												
40	Technology of metallurgical processes	Obtaining knowledge about the structure and properties of metallic, oxide and sulfide systems; about the basic laws of thermodynamics, mechanism and kinetics of the main metallurgical processes - liquation, distillation, redox processes, processes of processing of sulfide raw materials; exchange and oxidative leaching of compounds of various compositions, separation of metals from solutions by precipitation of insoluble compounds, cementation, sorption, about the main directions of development of the theory and practice of extraction and refining of metals, taking into account the integrated use of raw materials and modern environmental requirements; skills in performing calculations on thermodynamics and kinetics of metallurgical processes.	5							V	
41	Econometric modeling of metal recycling	This course is a generalization of students' knowledge in special disciplines, as well as an economic and mathematical description of technological processes for conducting experiments and studying them on a model. The concept of models and modeling, systems and their characteristics. Theories and similarity criteria for process modeling. Identification methods. Methods of developing information databases. Visualization and animation of models.	5							V	
42	Modern ecological schemes and forecasting in metallurgy	The impact of metallurgy on the environment. The main factors of environmental impact. Resource consumption. General principles of creating environmentally friendly metallurgy. The main requirements for environmentally friendly production are steel. Creation of environmentally friendly metallurgy. Comparative description of various methods of metallurgical production.	6							V	

43	Equipment of metallurgical workshops	Machines and aggregates for the preparation of charge materials for blast furnace melting. Bowl pelletizers of the charge. Blast furnace shop. Skip winches. Machines and aggregates of steelmaking production. Machines and units of oxygen converter shops. Melting furnaces. Horizontal converters. Scrubbers. Equipment for casting metals. Carousel filling machines. Carousel filling machines for zinc casting. Equipment for fire refining of copper.	4						V		
		Cycle of profile disciplines **Component of choice**									
44	Technology of waste disposal and disposal in industry	The main environmental problems of production and consumption of ferrous and non-ferrous metals. Hazard classes of toxic waste in metallurgy. Characteristics and classification of industrial waste. The main methods of recycling, neutralization and disposal of waste in industry. Disposal and neutralization of gases containing fluorine, chlorine, mercury, sulfur compounds and other harmful substances. Storage and disposal of industrial waste. Processing and disposal of industrial waste using full factory technology.	5						V		
45	Logistics of waste management	Terms, definitions and classification of waste. Legal regulation in the field of waste management in the countries of the European Union. Classification catalog of waste. Legal regulation of waste management activities in Kazakhstan. General strategy in waste management. Organization of a system for collecting solid, liquid and gaseous industrial waste. The use of production and consumption waste as secondary resources in the production of ferrous and non-ferrous metals. Heat treatment of waste. Waste disposal at landfills.	4						V		
46	Modeling of metallurgical processes	The concept of models and modeling, systems and their characteristics. Theories and similarity criteria for process modeling. Identification methods. Methods of developing information databases. Visualization and animation of models.	4						V		
47	Fundamentals of metallurgical production design	The design of metallurgical facilities is a field of knowledge, concepts and ideas about the design of industrial facilities, which is carried out for the purpose of developing and/or drawing up design estimates for the construction of new and/or changes to existing metallurgical facilities during their expansion, modernization, technical re–equipment, reconstruction, restoration, overhaul, conservation and postutilization. The design of metallurgical facilities must be carried out taking into account the provisions of current legislation and state regulations in the field of architectural, urban planning and construction activities.	4						V		
48	Recycling technologies in foundry	Technogenic foundry raw materials: steel and cast iron scrap of	6							V	

	production	complex composition. Metallurgical dust and briquettes. Metalworking waste: chips, trimmings, scale, including oil-containing. Melting in a cupola with the injection of metal-containing fine materials. Capture of sublimations of zinc, lead, tin, germanium and other valuable impurity elements. Steel and cast iron casting from a charge with a high content of impurity elements. Modern trends in the development of melting technology in a cupola for processing man-made and secondary raw materials.										
49	Recycling technologies in steel production	Movement of secondary metallurgical materials at a full-cycle enterprise. Trim, scale. Welding slag of rolling shops. Steel and cast iron scrap. Recycling in steelmaking units of scrap metal from parts with coatings, including organic materials. Steelmaking slags, slurries and dusts: micro-mixed composition, methods of safe storage and storage, processing in converters and hearth steelmaking units. The influence of scrap metal quality on the technology of steel smelting in open-hearth furnaces, oxygen converters and electric arc furnaces. Features of the use of technogenic raw materials in mini steelmaking plants. Requirements for charge materials and waste. Special technologies and aggregates for the processing of scrap metal and metallurgical dusts.	6							V	
50	Processes and devices for processing waste and secondary raw materials	Organization of collection, storage, delivery of scrap and waste of ferrous and non-ferrous metals, sources of their formation and directions of use. The main equipment for the primary processing of waste and secondary raw materials of ferrous and non-ferrous metals: sorting of scrap and waste, cutting and compacting of scrap and waste, separation of scrap and waste, storage and testing of secondary raw materials and waste. Auxiliary equipment for primary processing of waste and secondary raw materials of ferrous and non-ferrous metals. Equipment for metallurgical processing of waste and secondary raw materials of ferrous and non-ferrous metals: melting units, refining units. Auxiliary equipment of metallurgical processing.	5							V	
51	Digitalization of secondary metallurgy enterprises	The theory of building digital systems for various levels of production management at secondary metallurgy enterprises. Analysis of the structure, functional and supporting parts of digitalization, methodological foundations of building digital technologies. The role of digital technologies in improving the economic management mechanism at secondary metallurgy enterprises, as well as the construction of their information support. The use of digital technologies to optimize processes in order to	5							V	

		reduce the risk of injury to people working in hazardous areas. Technological process management and maintenance of secondary metallurgy enterprises through the use of intelligent analytical software packages and control in an integrated manner.										
52	Recycling of nonmetallurgical production waste	Features of waste disposal of the fuel industry and energy. Composition and metallurgical properties of coal enrichment and oil refining waste, energy ash and slag. Compaction, transportation, storage and preparation for metallurgical processing. Modern processing technologies, including metallurgical ones, their advantages and disadvantages. Disposal of transport waste. Special requirements of advanced industrial countries for the recycling of transport waste. Waste containing lead, materials with organic coatings, plastics of complex composition. Disposal of medical waste. Morphological and chemical composition, toxicity, metallurgical characteristics. Halogens: iodine, fluorine, chlorine; their behavior in metallurgical systems. Processing of food and medical waste in the agglomeration process. Special metallurgical technologies, PYROXEL process. Disposal of waste of the first hazard class. Modern requirements for recycling and classification of toxic waste.	5									V
53	Consumer properties of metallurgical products	Classification of steel products. General requirements for the consumer properties of steel products. The system of standardization and certification of metallurgical products. Metallurgical products of the mining and processing complex, mining and pig industry, nuclear industry and customer requirements for its properties.	5									V
54	Recycling technologies in metallurgy of heavy non-ferrous metals	Secondary raw materials of heavy non-ferrous metals. Preparation of secondary raw materials of heavy non-ferrous metals for metallurgical processing. Fundamentals and methods of pyro- and hydrometallurgical processing of secondary raw materials of heavy non-ferrous metals. Hardware design for the production of secondary heavy non-ferrous metals. Technology of recycling of waste and secondary raw materials of lead, copper, zinc, nickel. Auxiliary processes in the production of secondary heavy non-ferrous metals. Environmental and economic aspects of the production of secondary heavy non-ferrous metals.	5									V
55	Recycling technologies in light metal metallurgy	Sources of raw materials and characteristics of commercial products of secondary aluminum, titanium and magnesium enterprises. The processes of primary and metallurgical processing of scrap, aluminum, titanium and magnesium waste and the equipment used in this process. Fundamentals of designing technological schemes of	5									V

		workshops and factories for the production of secondary light metals, issues of economics, ecology, waste disposal and labor protection.										
56	Receipt, quality and certification of associated products during recycling	Features of metallurgical processes during melting "for slag". Blast furnace melting using man-made materials and obtaining slag of a given composition. Regularities of mass exchange between metal and slag. Formation of neutral compositions of elements - "vagants". Associated products of coke chemical production. The use of finely dispersed carbon-containing technogenic materials in the production of coke. Slag processing. Glazing of potentially dangerous and toxic compounds. Production of metallurgical gases of a given composition using man-made raw materials. Quality and certification of associated products.	5									V
57	Fundamentals of scientific research in secondary metallurgy	Definition of the concept of "science". Stages of development of metallurgical science in Kazakhstan. Organization of scientific research in the Republic of Kazakhstan. The forms of R&D and R&D, their significance. Methodological foundations of scientific knowledge. Processing and storage of scientific information. Stages of scientific research. Sampling and sample preparation, setting up a metallurgical experiment. Types and classification of scientific documentation. Errors, errors and their exclusion, correlation analysis of experimental data. Preparation of scientific documentation, presentation of research results. Efficiency and implementation of scientific developments. Directions of research in secondary metallurgy.	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, 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. 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 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.	5	KK3, KK7, KK8, KK9
6	Philosophy	Philosophy forms and develops critical and	5	KK4, KK5

		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.		
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	KK4, KK5
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 orientation from the standpoint of psychological aspects.	3	KK1, KK3, KK8, KK9
Cycle of general education disciplines Component of choice				
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	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	5	KK1, KK3, KK8, KK9

		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.		
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	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. Indefinite integrals, their properties and methods of calculation. Definite integrals and their applications. Improper integrals.	5	KK3, KK7, KK9
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	5	KK3, KK7, KK8, KK9

		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.		
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	KK3, KK7, KK9
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	KK3, KK7, KK9
16	Metals and their compounds	The discipline studies the physical and chemical properties of metals, their compounds and alloys, their ores, deposits, distribution in nature. The main methods of production, as well as the use of metals, their compounds and alloys in science and technology.	4	KK3, KK7, KK9
17	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 atomic structure and chemical bonding. Solutions and their types, redox processes, coordination compounds: formation, stability and properties. The structure of matter and the chemistry of elements.	5	KK3, KK7, KK8, KK9
18	General metallurgy	Production of cast iron and iron: raw materials and their preparation; the design of the blast furnace; the blast furnace process; equipment and operation of the sites servicing the blast furnace; the performance of blast furnaces; methods of non-domain (coke-free) iron production. Steel production: general fundamentals of steelmaking; converter steel production; open-hearth steel production; steel smelting in electric furnaces; ingots and casting of steel; continuous casting of steel; modern technologies for obtaining high-quality steel; non-furnace steel processing; complex technologies of non-furnace processing of cast iron and steel; production of steel in continuous units; remelting processes. Production of non-ferrous metals: metallurgy of copper; metallurgy of nickel; metallurgy of aluminum;	6	KK1, KK3, KK8, KK9

		production of other non-ferrous metals.		
19	Physical chemistry	To form students' ability to understand the physico-chemical essence of processes and use the basic laws of physical chemistry in complex production and technological activities. After mastering this discipline, the student should know: 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	KK4, KK5
20	Fundamentals of the specialty in secondary metallurgy	Characteristics of secondary raw materials, structural features, forms of finding ferrous, non-ferrous and valuable metals. Modern methods of recycling secondary raw materials. New processes of additional extraction of non-ferrous and valuable metals from secondary raw materials. Selection and justification of methods for processing secondary raw materials, economic analysis and assessment of their possible processing. Waste-free, environmentally friendly technologies for processing secondary raw materials with complex extraction of valuable metals. SWOT analysis of existing and new recycling processes.	5	KK1, KK3, KK8, KK9
21	Fundamentals of metal science	Structure of metals, atomic crystal structure and crystal lattices of metals. Real structure of metal crystals, anisotropy of crystal properties. Defects in the crystal structure. Methods of studying the structure of metals and alloys. Processes of crystallization, elastic and plastic deformation, recrystallization and melting of metals. Mechanical properties and destruction of metals. Fundamentals of the kinetics of phase transformations in metal alloys, the structure of alloys. Diagrams of the state of double and triple metal systems.	5	KK4, KK5
22	Theoretical foundations of metallurgical processes	Considers laws, theoretical provisions and conclusions on the structure and properties of metallic, oxide and sulfide systems: thermodynamics and kinetics of metallurgical processing of mineral and man-made raw materials, salt melts; liquation and distillation processes of production; methods of refining metals and the main directions of development of the theory and practice of extraction and refining of metals, taking into account the integrated use of raw materials and modern environmental requirements.	5	KK4, KK5, KK6
23	Production of ferrous and non-ferrous metal alloys from waste	The main melting processes of non-ferrous and ferrous metal alloys include theoretical, technological and constructive issues in the field of traditional and new metallurgy processes. Acquisition of competencies in the analysis of metal production technologies, development of technological schemes and designs of metallurgical units and carrying out technological calculations.	5	KK4, KK5, KK6
24	Design basics and machine parts	Basic requirements for machine parts and assemblies. Criteria for the operability of machine	5	KK4, KK5, KK6

		parts and methods of their evaluation. The concept of reliability and its main indicators. Basics of interchangeability. Mechanical transmissions and their classifications. Gears and their classification. Calculation of gear teeth for strength. Worm gears and their classification. Calculation of the strength of worm gears. Belt drives. Chain drives. Shafts and axles. Calculation of shafts for strength. Sliding and rolling bearings. Selection of rolling bearings. Types of connection. Calculation of the strength of the joint.		
25	Heat transfer and mass transfer in metallurgy	Heat power engineering of the agglomeration process. Heat power engineering of pellet firing. Heat power engineering of the blast furnace process. Heat exchange in a blast furnace. Heat transfer in a layer of lumpy materials. Factors affecting heat exchange processes. Thermal power engineering of converter production. The laws of mass and heat transfer. Mass and heat exchange in the baths of steelmaking units. Thermal balance of oxygen converter melting. Thermal losses of converters. The influence of technological parameters on the thermal operation of converters. Thermal power engineering of electric steelmaking processes. Features of thermal operation of electric furnaces. Energy balances of electric furnaces. Features of thermal operation of ferroalloy furnaces.	5	KK4, KK5, KK6
26	Design of secondary metallurgy enterprises	The design of metallurgical facilities and secondary metallurgy enterprises is a field of knowledge, concepts and ideas about the design of industrial facilities, which is carried out for the purpose of developing and/or drawing up design estimates for the construction of new and/or changes to existing metallurgical facilities during their expansion, modernization, technical re–equipment, reconstruction, restoration, overhaul, conservation and postutilization. The design of metallurgical facilities must be carried out taking into account the provisions of current legislation and state regulations in the field of architectural, urban planning and construction activities.	4	KK4, KK5, KK6
27	Theory and technology of coke-free metallurgy	In this discipline, the scientific foundations of the processes of coke-free metallurgy are considered. Experimental and industrial technologies of metal production in rotary and shaft furnaces, in the fluidized bed and in the melt are described. The issues of production of the final metal from metallized raw materials, as well as the production of reducing gases are considered.	5	KK1, KK2, KK7
Basic disciplines Component of choice				
28	Theory and technology of preparation of technogenic and secondary raw materials of ferrous and non-ferrous metallurgy for metallurgical processing	Scrap metal as technogenic raw materials 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 ferrous metal products and metallurgical technologies. Circulation of "vagants" in the technological	5	KK1, KK3, KK8, KK9

		cycle of metallurgical enterprises. Modern standards of the EU, USA and Japan, taking into account the presence of "vagants" in metallurgical raw materials. Preparation of technogenic energy resources. Plastics, solid waste, waste oils and lubricants. Methods of environmentally safe use of technogenic energy resources in metallurgical production.		
29	Recycling of fine industrial waste	The market of technogenic fine materials. Fine-dispersed solid household and industrial waste. Ash and slag waste. The concept of "shredding" technologies. Shredders. Composition and metallurgical characteristics of "shredding"-dusts. Meal, "heavy" and "light" fractions of shredding dust. Development and prospects of shredding technology. Compacting, briquetting, and caulking of fine technogenic materials. The role of ash and sludge accumulators in the structure of a modern ferrous metallurgy enterprise. Sludge processing technologies: current state and prospects. Agglomeration and production of pellets using man-made and recycled materials.	5	KK1, KK3, KK8, KK9
30	Wastewater treatment processes and devices	Properties and classification of waters according to their intended purpose. Issues of environmental safety of the hydrosphere. Fundamentals of water use in circulating and closed water supply systems of enterprises, as well as mechanical, chemical, physico-chemical, biochemical and thermal methods for removing soluble and insoluble contaminants from industrial wastewater. The main designs of devices, installations and structures for wastewater treatment from suspended and dissolved impurities. Constructive calculation of devices used in wastewater treatment: settling tanks, filters, flotators, adsorbers, electrolyzers, extractors, rectification plants, aerotanks and biofilters	5	KK4, KK5
31	Physico-chemical methods of analysis	The main types of physico-chemical methods of analysis: spectral, electrochemical, chromatographic. The theoretical principles of the methods, the device and principles of operation of analytical equipment, methods of computer processing of experimental results are described.	5	KK4, KK5
32	Continuous casting of steel	The importance of casting tasks for obtaining high-quality metal. Factors affecting the technical and economic indicators of production and quality of steel and electric fireplaces. A brief description of the main casting methods. The main physico-chemical, thermal and hydrodynamic problems of the studied discipline are considered. The concept of crystallization and solidification. Theory of casting of metals and alloys. Technologies of casting metals and alloys.	5	KK4, KK5, KK6
33	Recycling technologies in the metallurgy of rare metals	Characteristics of waste containing rare metals. Recycling of waste of molybdenum, tungsten and niobium alloys using oxidative methods, electrochemical methods and halogenation methods. Extraction of rhenium from fine and lumpy waste of heat-resistant nickel alloys (ZHNS). Recycling of scrap of electronic equipment containing rare metals using pyro-,	5	KK4, KK5, KK6

		hydrometallurgical technologies. Recycling of waste of tungsten steels and hard alloys with the processing of lump waste (scale, chips, edge trimming after rolling, unused parts of tool plates, their fragments, defective products, etc.) and pulverized abrasive materials (dust from sharpening of carbide tools). Extraction of indium from secondary raw materials by the amalgam method. Recycling of gallium-containing waste of radioelectronics and electronics, processing of gallium arsenide waste by thermal dissociation, fusing with alkali in the presence of an oxidizer, chlorination followed by rectification. Recycling of deactivated molybdenum-nickel, platinum-rhenium catalysts. Extraction of rhenium, molybdenum and tungsten from various solutions of hydrometallurgical processing of ore, technogenic and secondary raw materials. Extraction of germanium from dust formed during the processing of copper and zinc concentrates, from the dust of gas plants.		
34	Ecology of the metropolis	Assessment of the state of the natural environment under global changes; the main stages of the development of civilization and environmental crises characteristic of each of them; principles of respect for nature and sustainable development of civilization; methods of conducting field and laboratory environmental studies. Analysis of environmental processes and phenomena; formation of an ecological worldview based on the use of the provisions of the concept of sustainable development	5	KK1, KK2, KK7
35	Theory and technology of steelmaking processes	Steel production is the second stage of a two-stage scheme for extracting iron from ores by converting cast iron and metal waste into steel. The essence of steelmaking processes consists in the oxidation of impurities of cast iron and steel scrap (carbon, silicon, manganese, phosphorus and others) with iron oxides of slag, iron ore, pure oxygen or air oxygen and bringing the composition of the liquid metal to the composition of grade steel, followed by its deoxidation and alloying.	5	KK1, KK2, KK7
36	Dust collection and condensation in metallurgy	The course "Dust collection and condensation in metallurgy" aims to acquire students' knowledge and skills of working with equipment for dust collection and condensation in metallurgy. Students should know the theoretical and technological patterns of dust removal of particles processed during pyrometallurgical processes of materials depending on humidity, temperature, gas flow, size, as well as technological parameters during condensation of metal vapors and their compounds.	5	KK1, KK2, KK7
37	Special electrometallurgy	Basic laws of theoretical and applied electrochemistry. Technological bases of electrofining and electrodeposition of non-ferrous metals in aqueous and molten media, electroplating the surface of products, as well as obtaining metal powders under electrolysis conditions.	5	KK1, KK2, KK7
38	Processes of processing	Processing of secondary and man-made raw	6	KK1, KK2, KK8,

	of technogenic and secondary raw materials	materials of some heavy non-ferrous, noble, light and rare metals. The main sources of scrap and waste generation, their classification and characteristics. The design of the main and auxiliary equipment for the preparation of scrap and waste for metallurgical processing. Modern pyro- and hydrometallurgical methods of processing secondary and technogenic raw materials, basic technological schemes and hardware design of the processes of production of basic heavy, rare, light and precious metals from lump waste, slag, dust, sludge, industrial solutions and a number of other secondary and technogenic waste.		KK9
39	Technology of foundry production	A brief overview of the history of the technology of forming castings. The structure of the production of castings and the use of various technologies. The sequence of manufacturing a single casting mold. Schemes of technological processes for obtaining castings. Basic concepts and terms. The structure of the production of castings using various technologies. General technological schemes for the manufacture of castings. Types of foundry production.	6	KK1, KK2, KK8, KK9
Cycle of profile disciplines University component				
40	Technology of metallurgical processes	Obtaining knowledge about the structure and properties of metallic, oxide and sulfide systems; about the basic laws of thermodynamics, mechanism and kinetics of the main metallurgical processes - liquation, distillation, redox processes, processes of processing of sulfide raw materials; exchange and oxidative leaching of compounds of various compositions, separation of metals from solutions by precipitation of insoluble compounds, cementation, sorption, about the main directions of development of the theory and practice of extraction and refining of metals, taking into account the integrated use of raw materials and modern environmental requirements; skills in performing calculations on thermodynamics and kinetics of metallurgical processes.	5	KK1, KK2, KK8, KK9
41	Econometric modeling of metal recycling	This course is a generalization of students' knowledge in special disciplines, as well as an economic and mathematical description of technological processes for conducting experiments and studying them on a model. The concept of models and modeling, systems and their characteristics. Theories and similarity criteria for process modeling. Identification methods. Methods of developing information databases. Visualization and animation of models.	5	KK1, KK2, KK8, KK9
42	Modern ecological schemes and forecasting in metallurgy	The impact of metallurgy on the environment. The main factors of environmental impact. Resource consumption. General principles of creating environmentally friendly metallurgy. The main requirements for environmentally friendly production are steel. Creation of environmentally friendly metallurgy. Comparative description of various methods of metallurgical production.	6	KK1, KK2, KK8, KK9
43	Equipment of	Machines and aggregates for the preparation of	4	KK1, KK2, KK7

	metallurgical workshops	charge materials for blast furnace melting. Bowl pelletizers of the charge. Blast furnace shop. Skip winches. Machines and aggregates of steelmaking production. Machines and units of oxygen converter shops. Melting furnaces. Horizontal converters. Scrubbers. Equipment for casting metals. Carousel filling machines. Carousel filling machines for zinc casting. Equipment for fire refining of copper.		
Cycle of profile disciplines Component of choice				
44	Technology of waste disposal and disposal in industry	The main environmental problems of production and consumption of ferrous and non-ferrous metals. Hazard classes of toxic waste in metallurgy. Characteristics and classification of industrial waste. The main methods of recycling, neutralization and disposal of waste in industry. Disposal and neutralization of gases containing fluorine, chlorine, mercury, sulfur compounds and other harmful substances. Storage and disposal of industrial waste. Processing and disposal of industrial waste using full factory technology.	5	KK1, KK2, KK7
45	Logistics of waste management	Terms, definitions and classification of waste. Legal regulation in the field of waste management in the countries of the European Union. Classification catalog of waste. Legal regulation of waste management activities in Kazakhstan. General strategy in waste management. Organization of a system for collecting solid, liquid and gaseous industrial waste. The use of production and consumption waste as secondary resources in the production of ferrous and non-ferrous metals. Heat treatment of waste. Waste disposal at landfills.	4	KK1, KK2, KK7
46	Modeling of metallurgical processes	The concept of models and modeling, systems and their characteristics. Theories and similarity criteria for process modeling. Identification methods. Methods of developing information databases. Visualization and animation of models.	4	KK1, KK2, KK7
47	Fundamentals of metallurgical production design	The design of metallurgical facilities is a field of knowledge, concepts and ideas about the design of industrial facilities, which is carried out for the purpose of developing and/or drawing up design estimates for the construction of new and/or changes to existing metallurgical facilities during their expansion, modernization, technical re–equipment, reconstruction, restoration, overhaul, conservation and postutilization. The design of metallurgical facilities must be carried out taking into account the provisions of current legislation and state regulations in the field of architectural, urban planning and construction activities.	4	KK1, KK2, KK7
48	Recycling technologies in foundry production	Technogenic foundry raw materials: steel and cast iron scrap of complex composition. Metallurgical dust and briquettes. Metalworking waste: chips, trimmings, scale, including oil-containing. Melting in a cupola with the injection of metal-containing fine materials. Capture of sublimations of zinc, lead, tin, germanium and other valuable impurity elements. Steel and cast iron casting from a charge with a high content of impurity	6	KK1, KK2, KK8, KK9

		elements. Modern trends in the development of melting technology in a cupola for processing man-made and secondary raw materials.		
49	Recycling technologies in steel production	Movement of secondary metallurgical materials at a full-cycle enterprise. Trim, scale. Welding slag of rolling shops. Steel and cast iron scrap. Recycling in steelmaking units of scrap metal from parts with coatings, including organic materials. Steelmaking slags, slurries and dusts: micro-mixed composition, methods of safe storage and storage, processing in converters and hearth steelmaking units. The influence of scrap metal quality on the technology of steel smelting in open-hearth furnaces, oxygen converters and electric arc furnaces. Features of the use of technogenic raw materials in mini steelmaking plants. Requirements for charge materials and waste. Special technologies and aggregates for the processing of scrap metal and metallurgical dusts.	6	KK1, KK2, KK8, KK9
50	Processes and devices for processing waste and secondary raw materials	Organization of collection, storage, delivery of scrap and waste of ferrous and non-ferrous metals, sources of their formation and directions of use. The main equipment for the primary processing of waste and secondary raw materials of ferrous and non-ferrous metals: sorting of scrap and waste, cutting and compacting of scrap and waste, separation of scrap and waste, storage and testing of secondary raw materials and waste. Auxiliary equipment for primary processing of waste and secondary raw materials of ferrous and non-ferrous metals. Equipment for metallurgical processing of waste and secondary raw materials of ferrous and non-ferrous metals: melting units, refining units. Auxiliary equipment of metallurgical processing.	5	KK1, KK2, KK8, KK9
51	Digitalization of secondary metallurgy enterprises	The theory of building digital systems for various levels of production management at secondary metallurgy enterprises. Analysis of the structure, functional and supporting parts of digitalization, methodological foundations of building digital technologies. The role of digital technologies in improving the economic management mechanism at secondary metallurgy enterprises, as well as the construction of their information support. The use of digital technologies to optimize processes in order to reduce the risk of injury to people working in hazardous areas. Technological process management and maintenance of secondary metallurgy enterprises through the use of intelligent analytical software packages and control in an integrated manner.	5	KK1, KK2, KK8, KK9
52	Recycling of nonmetallurgical production waste	Features of waste disposal of the fuel industry and energy. Composition and metallurgical properties of coal enrichment and oil refining waste, energy ash and slag. Compaction, transportation, storage and preparation for metallurgical processing. Modern processing technologies, including metallurgical ones, their advantages and disadvantages. Disposal of transport waste. Special requirements of advanced industrial countries for the recycling of transport waste. Waste containing lead, materials with organic	5	KK1, KK2, KK8

		coatings, plastics of complex composition. Disposal of medical waste. Morphological and chemical composition, toxicity, metallurgical characteristics. Halogens: iodine, fluorine, chlorine; their behavior in metallurgical systems. Processing of food and medical waste in the agglomeration process. Special metallurgical technologies, PYROXEL process. Disposal of waste of the first hazard class. Modern requirements for recycling and classification of toxic waste.		
53	Consumer properties of metallurgical products	Classification of steel products. General requirements for the consumer properties of steel products. The system of standardization and certification of metallurgical products. Metallurgical products of the mining and processing complex, mining and pig industry, nuclear industry and customer requirements for its properties.	5	KK1, KK2, KK8
54	Recycling technologies in metallurgy of heavy non-ferrous metals	Secondary raw materials of heavy non-ferrous metals. Preparation of secondary raw materials of heavy non-ferrous metals for metallurgical processing. Fundamentals and methods of pyro- and hydrometallurgical processing of secondary raw materials of heavy non-ferrous metals. Hardware design for the production of secondary heavy non-ferrous metals. Technology of recycling of waste and secondary raw materials of lead, copper, zinc, nickel. Auxiliary processes in the production of secondary heavy non-ferrous metals. Environmental and economic aspects of the production of secondary heavy non-ferrous metals.	5	KK1, KK2, KK8
55	Recycling technologies in light metal metallurgy	Sources of raw materials and characteristics of commercial products of secondary aluminum, titanium and magnesium enterprises. The processes of primary and metallurgical processing of scrap, aluminum, titanium and magnesium waste and the equipment used in this process. Fundamentals of designing technological schemes of workshops and factories for the production of secondary light metals, issues of economics, ecology, waste disposal and labor protection.	5	KK1, KK2, KK8
56	Receipt, quality and certification of associated products during recycling	Features of metallurgical processes during melting "for slag". Blast furnace melting using man-made materials and obtaining slag of a given composition. Regularities of mass exchange between metal and slag. Formation of neutral compositions of elements - "vagants". Associated products of coke chemical production. The use of finely dispersed carbon-containing technogenic materials in the production of coke. Slag processing. Glazing of potentially dangerous and toxic compounds. Production of metallurgical gases of a given composition using man-made raw materials. Quality and certification of associated products.	5	KK1, KK2, KK8
57	Fundamentals of scientific research in secondary metallurgy	Definition of the concept of "science". Stages of development of metallurgical science in Kazakhstan. Organization of scientific research in the Republic of Kazakhstan. The forms of R&D and R&D, their significance. Methodological	5	KK1, KK2, KK8

		foundations of scientific knowledge. Processing and storage of scientific information. Stages of scientific research. Sampling and sample preparation, setting up a metallurgical experiment. Types and classification of scientific documentation. Errors, errors and their exclusion, correlation analysis of experimental data. Preparation of scientific documentation, presentation of research results. Efficiency and implementation of scientific developments. Directions of research in secondary metallurgy.		

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
Chairman of the Management Board-
Rector of KazNITU named after K.Satpayev
M.M. Begentaev
2022 y.

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

Educational program 6B07212 - "Recycling in metallurgy"
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**

Discipline code	Name of disciplines	Cycle	Total amount in credits	Total hours	classroom volume of lek/lab/pr	SIS (including TSIS) in hours	Form of control	Allocation of face-to-face training based on courses and semesters							
								I course		II course		III course		IV course	
								1 semester	2 semester	3 semester	4 semester	5 semester	6 semester	7 semester	8 semester
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)															
M-1. Module of language training															
LNG108	English language	GED, RC	10	300	0/0/6	210	E	5	5						
LNG104	Kazakh (Russian) language	GED, RC	10	300	0/0/6	210	E	5	5						
M-2. Module of physical training															
KFK101-104	Physical Culture	GED, RC	8	240	0/0/8	120	Difcredit	2	2	2	2				
M-3. Module of information technology															
CSE677	Information and communication technologies (in English)	GED, RC	5	150	2/1/0	105	E				5				
M-4. Module of socio-cultural development															
HUM100	Modern History of Kazakhstan	GED, RC	5	150	1/0/2	105	SE		5						
HUM132	Philosophy	GED, RC	5	150	1/0/2	105	E				5				
HUM120	Socio-political knowledge module (sociology, politology)	GED, RC	3	90	1/0/1	60	E				3				
HUM134	Socio-political knowledge module (culturology, psychology)	GED, RC	5	150	2/0/1	105	E			5					
M-5. Module of anti-corruption culture, ecology and life safety base															
HUM133	Fundamentals of anti-corruption culture	GED, CCH	5	150	2/0/1	105	E			5					
MNG488	Fundamentals of Entrepreneurship and Leadership	GED, CCH													
CHE656	Ecology and life safety	GED, CCH													
CYCLE OF BASIC DISCIPLINES (BD)															
M-6. Module of physical and mathematical training															
MAT101	Mathematics I	BD, UC	5	150	1/0/2	105	E	5							
PHY111	Physics I	BD, UC	5	150	1/1/1	105	E	5							
MAT102	Mathematics II	BD, UC	5	150	1/0/2	105	E		5						
M-7. Module of basic training															
GEN429	Engineering and computer graphics	BD, UC	5	150	1/0/2	105	E	5							
CHE495	Chemistry	BD, UC	5	150	1/1/1	105	E		5						
CHE127	Physical chemistry	BD, UC	5	150	1/1/1	105	E				5				
2201	Elective	BD, CCH	5	150	2/1/0*	105	E			5					
2202	Elective	BD, CCH	5	150	2/1/0*	105	E				5				
3203	Elective	BD, CCH	5	150	2/1/0*	105	E					5			
3204	Elective	BD, CCH	5	150	2/1/0*	105	E						5		
3205	Elective	BD, CCH	5	150	2/1/0*	105	E						5		
4206	Elective	BD, CCH	6	180	2/1/1*	120	E							6	
AAP179	Educational practice	BD, UC	2		0/0/2				2						
M-8. Basic training module on metal recycling															
MET185	Mineralogy and deposits of minerals	BD, UC	4	120	2/0/1	75	E	4							
MET500	General metallurgy	BD, UC	6	180	2/0/1	120	E			6					
MET627	Fundamentals of the specialty in secondary metallurgy	BD, UC	5	150	2/0/1	105	E			5					
MET628	Fundamentals of metal science	BD, UC	5	150	2/1/0	105	E				5				
MET639	Theoretical foundations of metallurgical processes	BD, UC	5	150	2/1/0	105	E					5			
MET 629	Production of ferrous and non-ferrous metal alloys from waste	BD, UC	5	150	2/1/0	105	E					5			
GEN 125	Bases of designing and details of cars	BD, UC	5	150	2/1/0	105	E					5			
MET 640	Heat transfer and mass transfer in metallurgy	BD, UC	5	150	2/0/1	105	E					5			
MET 633	Design of secondary metallurgy enterprises	BD, UC	4	120	2/0/1	75	E					4			
MET566	Theory and technology of non-coke metallurgy	BD, UC	5	150	2/0/1	105	E						5		
CYCLE OF PROFILE DISCIPLINES (PD)															
M-9. Module of professional activity on metal recycling															
MET 123	Technology of metallurgical processes	PD, UC	5	150	2/0/1	105	E							5	
MET 632	Econometric modeling of metal recycling	PD, UC	5	150	2/1/0	105	E							5	
MET 618	Modern ecological schemes and forecasting in metallurgy	PD, UC	6	180	2/0/1	120	E							6	
TEC 481	Equipment of metallurgical shops	PD, UC	4	120	2/0/1	75	E						4		
M-10. Professional activity module															
3301	Elective	PD, CCH	5	150	2/1/0*	105	E						5		
3302	Elective	PD, CCH	4	120	2/1/0*	75	E						4		
4303	Elective	PD, CCH	6	180	2/1/1*	120	E							6	

4304	Elective	PD, CCH	5	150	2/1/0*	105	E							5	
4305	Elective	PD, CCH	5	150	2/1/0*	105	E								5
4306	Elective	PD, CCH	5	150	2/1/0*	105	E								5
AAP143	Production practice I	PD, UC	2		0/0/2						2				
AAP183	Production practice II	PD, UC	3		0/0/3								3		
M-11. Module of "R&D"															
4307	Elective	PD, CCH	5	150	2/1/0*	105	E								5
M-12. Module of final attestation															
ECA003	Preparation and writing of a thesis (project)	FA	6												6
ECA103	Defense of the thesis (project)	FA	6												6
M-13. Module of additional types of training															
AAP500	Military affairs	ATT	0												
	Total based on UNIVERSITY:							31	29	28	32	29	31	33	27
								60		60		60		60	

Number of credits for the entire period of study					
Cycle code	Cycles of disciplines	Credits			
		required component (RC)	university component (UC)	component of choice (CCH)	Total
GED	Cycle of general education disciplines	51		5	56
BD	Cycle of basic disciplines		81	31	112
PD	Cycle of profile disciplines		25	35	60
	Total for theoretical training:	*51*	*106*	*71*	*228*
FA	Final attestation	12			12
	TOTAL:	**63**	**106**	**71**	**240**

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

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

Decision of the Academic Council of MaMI named after O. Baikonurov. Protocol № 5 от "20" 12 2021 y.

Vice-Rector for Academic Affairs — **B.A. Zhautikov**

Director of the Mining and Metallurgical Institute named after O. A. Baikonurov — **K.B. Rysbekov**

Head of department "Metallurgy and mineral processing" — **M.B. Barmenshinova**

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

Representative of the employers' council of the LLP "KazFerroStals" — **R.R. Protsenko**

Representative of the employers' council of the Weizmann Research Institute — **V.A. Kaplan**

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