Non-profit joint-stock company «Kazakh national research technical University named after K.I. Satbayev»
Mining and metallurgical Institute named after O.A. Baykonurov
Department of «Metallurgy and mineral processing»
Department of «Metallurgical processes, heat engineering and special materials technology»

Educational program
7M07204 - "METALLURGY AND MINERAL PROCESSING"
Master of Technical Sciences

based on the following specialty that has lost the validity of the Classifier of the specialty: 6M070900 - Metallurgy

1st edition
in accordance with the SES of Higher Education 2018

Almaty 2021

The program is drawn up and signed by the parties:

from KazNRTU named after K.I. Satbayev

1. Head of the Department «MaMP» — Barmenshinova M.B.
2. Head of the Department «MPHEaTSM» — Chepushtanova T.A.
3. Director of the mining and metallurgical Institute named after O. A. Baykonurov — Rysbekov K.B.
4. Chairman of the TG of the departments «MaMP» and «MPHEaTSM», professor — Baimbetov B.S.

from the employer

1. First Deputy Executive Director of the DLE «AMaME» — Mukhanov T.M.
2. Head Of the Department of complex processing of technogenic raw materials of "Kazakhmys" LLP, Dr. Techn. sciences — Ospanov E.A.
3. Chief concentrator of "KAZ Minerals" LLP — Dzhetybayeva U.K.

from the partner university:

Worcester Polytechnic Institute (USA) — Mishra B.

Approved at the meeting of the Educational and methodological Council Of the Kazakh national research technical University named after K. I. Satpayev. Protocol No. 3 of 25.06.2021.

Qualifications:

Level 7 of the National qualifications framework:
7M07 Engineering, manufacturing and construction industries
7M072 Manufacturing and processing industries (master's degree)

Professional competence:

The solution of organizational and production tasks in the implementation of innovative projects in the field of mineral processing and metallurgy, preparation for the development of plans and programs for the organization of innovative activities at enterprises of mineral processing and metallurgy along the entire chain of the innovation cycle "fundamental research - R&D – production of new types of products", possession of modern methods and techniques of working with personnel, methods of creating innovative teams, possession of modern methods of digital format of mineral processing and digital metallurgy.

Brief description of the program:

1 The objectives of the educational program of the scientific and pedagogical master's degree in the field of Metallurgy and mineral processing are:

- formation of personnel for the innovative economy in metallurgy and mineral processing, covering modern energy-saving technologies, project activities, innovative solutions, entrepreneurship in the high-tech field of mineral processing;
- formation of skills of design and decision-making, culture of self-government, organization of communication and coordination of points of view, design and presentation of results, use of modern software products and technical means, technological process management, management of preparation and loading of equipment, control over the condition of equipment and rational use of raw materials and materials;
- skills of conducting innovative production management in the field of mineral processing and metallurgy;
- development of personal scientific and metric indicators of the student;
- formation of skills for planning and conducting research in the field of metallurgy and mineral processing, teaching activities in universities.

2 Types of professional activity

Graduates of the educational program of the scientific and pedagogical master's degree "Metallurgy and mineral processing" can perform the following types of professional activities: design, production and technological, organizational and managerial, research and pedagogical.

A distinctive feature of the master's degree program is that the educational program provides knowledge, skills and abilities on the use of energy-saving and "green" technologies and materials, production and sale of products of processing and metallurgical processing; on the development of regulatory and technical documentation of the mining and processing and mining and metallurgical sector; on the improvement and preparation of mining and metallurgical production facilities. Graduates gain knowledge in the field of development and implementation of processing and metallurgical technologies, production of innovative metallurgical products, increased consumer properties; graduates have high leadership and organizational qualities; are capable of creating small knowledge-intensive mining and metallurgical businesses.

The mission of the Master's degree program "Metallurgy and mineral processing" on the basis of the specialty 6M070900-"Metallurgy" is the formation of students' social and personal qualities and professional competencies that allow graduates to successfully solve production and technological, organizational and managerial, project tasks in the field of mineral processing and metallurgy, and contribute to their sustainable demand in the labor market, as well as compliance with international educational standards; providing enterprises with highly qualified specialists in the field of metallurgy and mineral processing, specializing in the implementation of promising

fundamental, innovative, digital and applied research and development and implementation of modern technological processes that ensure high quality products with minimal costs.

3. 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, branch research and design institutes, factory laboratories, higher and secondary vocational educational institutions, state management bodies and organizations of various organizational and legal forms.

Types and subjects of professional activity.

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

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

The education level code is 07 Engineering, Manufacturing and construction industries, 7 Technical Sciences and Technologies, 7M072 - Manufacturing and processing industries.

PASSPORT OF THE EDUCATIONAL PROGRAM

Scope and content of the program

The duration of the master's degree is determined by the amount of academic credits mastered. Upon mastering the established amount of academic credits and achieving the expected learning outcomes for obtaining a master's degree, the Master's degree program is considered fully mastered. The scientific and pedagogical Master's degree program provides 125 academic credits for the entire period of study, including all types of educational and scientific activities of a graduate student.

Planning of the content of education, the way of organizing and conducting the educational process is carried out by the university and the scientific organization independently on the basis of credit technology of training.

The Master's degree in scientific and pedagogical direction implements educational programs of postgraduate education for the training of scientific and scientific-pedagogical personnel for universities and scientific organizations with in-depth scientific-pedagogical and research training.

The content of the Master's degree program consists of:

1) theoretical training, including the study of cycles of basic and core disciplines;

2) practical training of undergraduates: various types of practices, scientific or professional internships;

3) research work, including the implementation of a master's thesis for a scientific and pedagogical master's degree

4) final certification.

The content of the educational program includes the following modules: general education, general engineering, engineering and technical and professional modules.

The educational program includes the following stages of preparation of undergraduates: history and philosophy of science, pedagogy of higher education, foreign language (professional), management psychology, theory of metallurgical engineering processes, modern and promising technologies for processing raw materials of ferrous and non-ferrous metallurgy, special methods of hydrometallurgy, chlorine and vacuum technologies in metallurgy, engineering calculations in metallurgy, technologies and processes of rectification and condensation in metallurgy, modern and promising technologies for processing ore and man-made raw materials, technology and refining of radioactive metals, technology and refining of precious metals, innovations in materials science, mass transfer in heterophase metallurgical systems, special chapters of extractive metallurgy (in English), electrolysis of aqueous and non-aqueous media, recycling technologies in ferrous and non-ferrous metallurgy, processes and production of especially pure metals, technologies for extracting metals from slags, technology for fractional separation of metals from a vapor-gas mixture.

The ability to choose disciplines from the catalog of elective disciplines of Satbayev University.

The objectives of the educational program are:

1. Competence of graduates in design and technological work in the implementation of projects to improve and optimize processing and metallurgical processes, increase their productivity and improve the quality of products.

2. Competence of graduates in the implementation of the development and implementation of technological processes for processing mineral, natural and man-made raw materials;

3. Competence of graduates in the assessment of innovation and technological risks in the introduction of new technologies;

4. Competence of graduates in the system of digitalization of mineral processing and metallurgy industries. Acquisition of competencies in production management at all stages of the life cycle of manufactured products;

5. Competence in the marketing of high-tech technologies.

2 Requirements for applicants

The previous level of education of applicants is higher professional education (bachelor's degree). The applicant must have a diploma of the established sample and confirm the level of knowledge of the English language with a certificate or diplomas of the established sample.

The procedure for admission of citizens to the magistracy is established in accordance with the "Standard rules for admission to training in educational organizations implementing educational programs of postgraduate education".

The formation of a contingent of undergraduates is carried out by placing a state educational order for the training of scientific and pedagogical personnel, as well as paying for training at the expense of citizens' own funds and other sources. The State provides citizens of the Republic of Kazakhstan with the right to receive free postgraduate education on a competitive basis in accordance with the state educational order, if they receive education of this level for the first time.

At the "entrance", a master's student must have all the prerequisites necessary to master the relevant master's degree program. The list of necessary prerequisites is determined by the higher educational institution independently.

In the absence of the necessary prerequisites, the undergraduate is allowed to master them on a paid basis.

3 Requirements for completing studies and obtaining a diploma

Degree/qualifications awarded: The graduate of this educational program is awarded the academic degree "Master of Technical Sciences" in the direction of "Metallurgy and mineral processing".

A graduate who has mastered the Master's degree program must have the following general professional competencies:

- the ability to independently acquire, comprehend, structure and use new knowledge and skills in professional activities, develop their innovative abilities;

- the ability to independently formulate research goals, establish the sequence of solving professional tasks;

- the ability to apply in practice the knowledge of fundamental and applied sections of disciplines that determine the orientation (profile) of the master's degree program;

- the ability to professionally choose and creatively use modern scientific and technical equipment to solve scientific and practical problems;

- the ability to critically analyze, present, defend, discuss and disseminate the results of their professional activities;

- proficiency in the preparation and execution of scientific and technical documentation, scientific reports, reviews, reports and articles;

- willingness to lead a team in the field of their professional activities, tolerantly perceiving social, ethnic, confessional and cultural differences;

- readiness to communicate orally and in writing in a foreign language to solve the tasks of professional activity.

A graduate who has mastered the master's degree program must have professional competencies corresponding to the types of professional activities that the master's degree program is focused on:

research activities:

- the ability to form diagnostic solutions to professional problems by integrating fundamental sections of sciences and specialized knowledge acquired during the development of the master's degree program;

- the ability to independently conduct scientific experiments and research in the professional field, generalize and analyze experimental information, draw conclusions, formulate conclusions and recommendations;

- the ability to create and explore models of the studied objects based on the use of in-depth theoretical and practical knowledge in the field of metallurgy and mineral processing;

- scientific and production activities:

- the ability to independently carry out production and scientific-production, laboratory and interpretive work in solving practical problems;

- the ability to professionally operate modern laboratory equipment and devices in the field of the master's degree program;

- the ability to use modern methods of processing and interpreting complex information to solve production problems;

- project activity:

- the ability to independently draw up and submit projects of research and scientific production works;

- readiness to design complex research and scientific-production works in solving professional tasks;

- organizational and managerial activity:

- readiness to use practical skills of organization and management of research and scientific-production works in solving professional tasks;

- readiness for the practical use of regulatory documents in the planning and organization of scientific and production work;

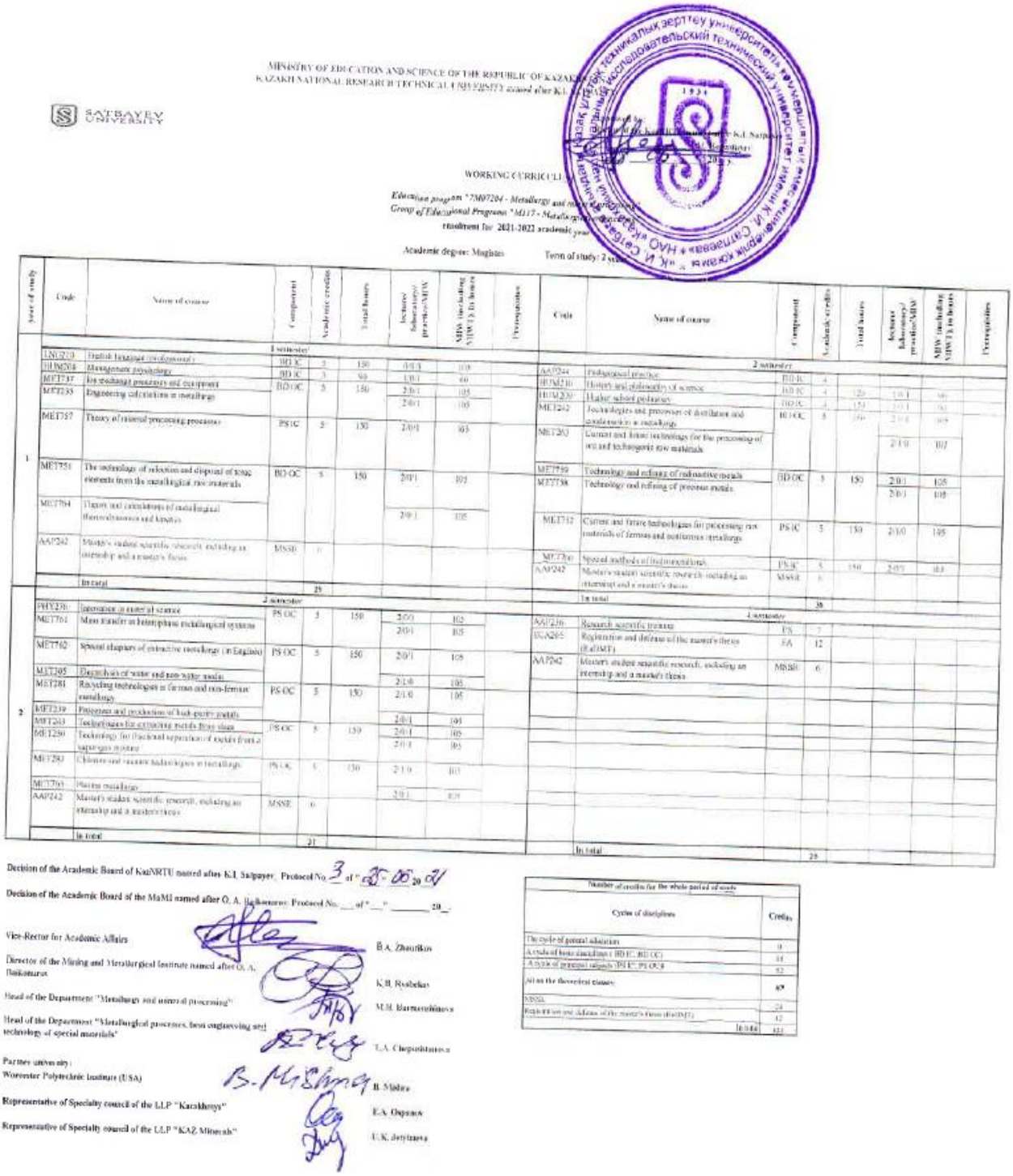
- scientific and pedagogical activity:

- the ability to conduct seminars, laboratory and practical classes;

- the ability to participate in the management of scientific and educational work of students in the field of metallurgy and enrichment.

When developing a master's degree program, all general cultural and general professional competencies, as well as professional competencies related to those types of professional activities that the master's program is focused on, are included in the set of required results of mastering the master's program.

4 Working 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

WORKING CURRICULUM

Education program "7M07204 - Metallurgy and mineral processing"
Group of Educational Programs "M117 - Metallurgical engineering"
Enrollment for 2021-2022 academic year

Academic degree: Magistr Term of study: 2 years

Year of study	Code	Name of course	Component	Academic credits	Total hours	Lectures/ laboratory/ practice/SRW	SRW (including SRWT) in hours	Prerequisites
		1 semester						
1	ENG220	English language (professional)	BD OC	3	150	0/0/3	105	
	HUM208	Management psychology	BD OC	3	90	1/0/1	60	
	MET237	Ore mechanical processes and equipment	BD OC	5	150	2/0/1	105	
	MET235	Engineering calculations in metallurgy				2/0/1	105	
	MET757	Theory of mineral processing processes	PS OC	5	150	2/0/1	105	
	MET751	The technology of selection and disposal of toxic elements from the metallurgical raw materials	BD OC	5	150	2/0/1	105	
	MET764	Theory and calculations of metallurgical thermodynamics and kinetics				2/0/1	105	
	AAP242	Master's student scientific research, including an internship and a master's thesis	MSSR	6				
		In total		25				
		2 semester						
2	PHY238	Innovation in matter of science	PS OC	5	150	2/0/1	105	
	MET761	Mass transfer in heterophase metallurgical systems				2/0/1	105	
	MET762	Special chapters of extractive metallurgy (in English)	PS OC	5	150	2/0/1	105	
	MET305	Electrolysis of water and non-water media				2/1/0	105	
	MET281	Recycling technologies in ferrous and non-ferrous metallurgy	PS OC	5	150	2/1/0	105	
	MET239	Processes and production of high-purity metals				2/0/1	105	
	MET243	Technologies for extracting metals from slags	PS OC	5	150	2/0/1	105	
	MET250	Technology for fractional separation of oxides from a supergene product				2/0/1	105	
	MET283	Chemical vacuum technologies in metallurgy	PS OC	5	150	2/1/0	105	
	MET765	Plasma metallurgy				2/0/1	105	
	AAP242	Master's student scientific research, including an internship and a master's thesis	MSSR	6				
		In total		21				

Year of study	Code	Name of course	Component	Academic credits	Total hours	Lectures/ laboratory/ practice/SRW	SRW (including SRWT) in hours	Prerequisites
		2 semester						
1	AAP244	Pedagogical practice	BD EL	4				
	HUM210	History and philosophy of science	BD OC	4	120	1/0/1	90	
	HUM209	Higher school pedagogics	BD OC	4	120	1/0/1	90	
	MET242	Technologies and processes of distillation and condensation in metallurgy	BD OC	5	150	2/1/0	105	
	MET303	Current and future technologies for the processing of ore and technogenic raw materials				2/1/0	105	
	MET759	Technology and refining of radioactive metals	BD OC	5	150	2/0/1	105	
	MET758	Technology and refining of precious metals				2/0/1	105	
	MET752	Current and future technologies for processing raw materials of ferrous and nonferrous metallurgy	PS OC	5	150	2/1/0	105	
	MET760	Special methods of thermodynamics	PS OC	5	150	2/0/1	105	
	AAP242	Master's student scientific research, including an internship and a master's thesis	MSSR	6				
		In total		30				
		4 semester						
	AAP236	Research scientific training	PA	7				
	EGA205	Registration and defense of the master's thesis (ExAMT)	FA	12				
	AAP242	Master's student scientific research, including an internship and a master's thesis	MSSR	6				
		In total		25				

Decision of the Academic Board of KazNRTU named after K.I. Satpayev. Protocol No. 3 of "25" 06 2021

Decision of the Academic Board of the MaMI named after O. A. Baikonurov. Protocol No. __ of "__" _____ 20__

Vice-Rector for Academic Affairs — B.A. Zhanfillov

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

Head of the Department "Metallurgy and mineral processing" — M.M. Barmenshinova

Head of the Department "Metallurgical processes, heat engineering and technology of special materials" — L.A. Chepushtanova

Partner university:
Worcester Polytechnic Institute (USA) — B. Miller

Representative of Specialty council of the LLP "Kazakhmys" — E.A. Ospanov

Representative of Specialty council of the LLP "KAZ Minerals" — U.K. Zeytunova

Number of credits for the whole period of study

Cycles of disciplines	Credits
The cycle of general education	0
A cycle of basic disciplines (BD EC, BD OC)	34
A cycle of profile disciplines (PS EC, PS OC)	52
All on the theoretical classes	69
MSSR	24
Registration and defense of the master's thesis (ExAMT)	12
In total	121

5 Descriptors of the level and scope of knowledge, skills, skills and competencies

The requirements for the master's degree level are determined on the basis of the Dublin descriptors of the second level of higher education (Master's degree) and reflect the acquired competencies expressed in the achieved learning outcomes.

Learning outcomes are formulated both at the level of the entire master's degree program, and at the level of individual modules or academic discipline.

Descriptors reflect learning outcomes that characterize the student's abilities:

1) demonstrate developing knowledge and understanding in the field of metallurgy and mineral processing under study, based on advanced knowledge of metallurgy and mineral processing, when developing and (or) applying ideas in the context of research;

2) apply their knowledge, understanding and abilities at a professional level to solve problems in a new environment, in a broader interdisciplinary context;

3) to collect and interpret information for the formation of judgments taking into account social, ethical and scientific considerations;

4) clearly and unambiguously communicate information, ideas, conclusions, problems and solutions to both specialists and non-specialists;

5) training skills necessary for independent continuation of further training in the studied field of metallurgy and mineral processing.

6 Competencies upon completion of training

6.1 Requirements for the key competencies of graduates of the *scientific and pedagogical Master's degree*, must:

1) have an idea:

- on the role of science and education in public life;
- about current trends in the development of scientific knowledge;
- on current methodological and philosophical problems of natural sciences;
- about the professional competence of a high school teacher;
- contradictions and socio-economic consequences of globalization processes;
- about the latest discoveries in the chosen field of activity, the prospects of their use for the construction of technical systems and devices;
- mathematical and physical modeling of systems in the field of technology and equipment development;
- about design, research, inventive, innovative activities in the field of mineral processing and metallurgy;
- about the possibilities of advanced scientific methods and technical means, to use them at the level necessary for the study of mining and metallurgical processes and equipment.

2) know:

- methodology of scientific knowledge;
- principles and structure of the organization of scientific activity;

- psychology of cognitive activity of students in the learning process;
- psychological methods and means of improving the effectiveness and quality of training;
- international and domestic standards, resolutions, orders, orders of higher and other domestic organizations, methodological normative and guidance materials related to the work performed;
- current state and prospects of technical and technological development of processing and metallurgical processes, features of the activities of institutions, organizations, enterprises and related industries;
- goals and objectives facing a specialist in the field of mineral processing and metallurgy for the development and implementation of the latest high-tech production technologies;
- methods of research of processing and metallurgical processes, equipment operation;
- basic requirements for technical documentation of materials and products;
- rules and norms of labor protection, issues of environmental safety of technological processes;
- methods of expert assessment in the field of life safety and environmental protection;
- standards in the field of quality management;
- achievements of science and technology, advanced domestic and foreign experience in the field of mineral processing and metallurgy;
– at least one foreign language at a professional level that allows conducting scientific research and practical activities;
- the methodology of conducting all types of training sessions and independent work of students.

3) be able to:

- to develop technological processes for obtaining conditioned concentrates from ore, as well as metals from concentrates, processing of metals and alloys, schemes of processing and metallurgical processes, to justify operating parameters and indicators;
- to make a business plan for a technological project;
- develop energy- and resource-saving technologies in the field of mineral processing, metallurgy and metalworking;
- develop environmental protection measures for enrichment and metallurgical production;
- carry out planning of experimental studies, choose research methods;
- to develop the scheme and design of the experimental installation, to carry out installation and debugging;
- process data using planning techniques, regression and correlation analysis, digitalization methods;

- to carry out measures for the organization of production in accordance with regulatory documents;
- to use the acquired knowledge for the original development and application of ideas in the context of scientific research;
- critically analyze existing concepts, theories and approaches to the analysis of processes and phenomena;
- integrate knowledge gained in different disciplines to solve research problems in new unfamiliar conditions;
- by integrating knowledge to make judgments and make decisions based on incomplete or limited information;
- apply the knowledge of pedagogy and psychology of higher education in their teaching activities;
- apply interactive teaching methods;
- to carry out information-analytical and information-bibliographic work with the involvement of modern information technologies;
- to think creatively and creatively approach the solution of new problems and situations;
- be fluent in a foreign language at a professional level, which allows conducting scientific research and teaching special disciplines in universities;
- summarize the results of research and analytical work in the form of a dissertation, scientific article, report, analytical note, etc.;

4) have the skills:

- research activities, solutions of standard scientific tasks;
- implementation of educational and pedagogical activities on credit technology of training;
- methods of teaching professional disciplines;
- the use of modern information technologies in the educational process;
- professional communication and intercultural communication;
- oratory, correct and logical formalization of their thoughts in oral and written form;
- expanding and deepening the knowledge necessary for daily professional activities and continuing education in doctoral studies.

5) be competent:

- in the field of research methodology;
- in the field of scientific and scientific-pedagogical activity in higher educational institutions;
- in matters of modern educational technologies;
- in the implementation of scientific projects and research in the professional field;
- in ways to ensure constant updating of knowledge, expansion of professional skills and abilities.

B - Basic knowledge, skills and abilities

B1 - Know the history and philosophy of science, pedagogy and psychology;

B 2 - The ability to independently apply methods and means of cognition, learning and self-control to acquire new knowledge and skills, including in new areas directly unrelated to the field of activity.

B 3 - To speak the state, Russian and one of the most common foreign languages in the industry at the level that provides 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 - Proficiency in professional terminology and the ability to work with educational and scientific materials in the specialty in the original in a foreign language. The ability to logically correctly, argumentatively and clearly build oral and written speech.

B6 - General engineering skills.

B7 - Possession of fundamental knowledge on the theory of mineral processing and metallurgical processes;

B8 - Basic knowledge of waste management, metal recycling.

B9 - Possession of modern and promising technologies of metallurgical production.

B10 - To know and own the main business processes in an industrial enterprise.

B11 - The ability to conduct pedagogical work using modern techniques and technologies.

P - Professional competencies:

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

P2 - is able to analyze technological lines of mineral processing and metallurgical processes.

P3 - ready to install, adjust and operate production systems for mineral processing and metallurgical processes;

P4 - ready to participate in the development and design of new technologies and production lines for mineral processing, production of finished metal-containing products.

P5 - Have the skills of drawing up an equipment and technological scheme

P6 - Possess the skills to carry out technological, thermal and energy calculations

P7 - Be able to calculate aero- and hydrodynamics according to the circuit diagram of the apparatus

P8 - Be able to calculate and select the main and auxiliary equipment

P9 - Be able to develop and select drawings of equipment, buildings and structures

P10 - Be able to develop technological processes for the production and processing of metals and alloys

P11 - Be able to develop a scheme of enrichment and metallurgical processes, justify the operating parameters and indicators

P12 - Be able to make a business plan for a technological project

P13 - Be able to develop energy- and resource-saving technologies in the field of metallurgy and metalworking

P14 - Be able to develop environmental protection measures for metallurgical production

P15 - Be able to conduct a literary search, compile reports, reviews, conclusions, etc., choose research methods, plan and conduct necessary experiments, analyze and summarize research results, issue patents

P16 - Mastering the technology of processing slags and industrial products of non-ferrous and ferrous metallurgy for additional extraction of valuable components and solving environmental problems of the industrial region

P17 -the Ability to use knowledge, skills, mastered in preparation for the development of the methodology of scientific research related to the professional field and to organize the experiments and analyzing the results

P18 - Identify issues of modernization and introduction of new technologies and equipment for intensification processing and metallurgical processes in order of increasing extract the contained valuable components

P19 - Possess practical skills in the field of independent organization and management of research works on the topic

P20 - The ability to apply the knowledge, skills, and skills acquired in the process of studying under the Master's degree program.

O - Universal, social and ethical competencies

O1 - is able to use English fluently as a means of business communication, a source of new knowledge in the field of automation or robotization of production processes. I am ready to use English in my professional activities in the field of enrichment and metallurgy;

O2 - is able to speak Kazakh (Russian) fluently as a means of business communication, a source of new knowledge in the field of automation or robotization of production processes. I am ready to use the Kazakh (Russian) language in my professional activity in the field of enrichment and metallurgy;

O3 - to know and apply in work and life the basics of applied ethics and ethics of business communication;

O4 - know and apply the basic concepts of professional ethics;

O5 - to know and solve the problems of human influence on the environment.

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 problems, reasoning conclusions and competent information management;

C2 - to be a specialist in conducting experimental studies of ore processing facilities and metallurgy;

C3 - to be a researcher, a specialist in scientific research of ore processing facilities and objects of finished metal-containing products;

C4 - to be an engineer for the development and design of processing and metallurgical workshops, factories, production lines.

6.2 Requirements for the research work of a master's student in the scientific and pedagogical magistracy:

1) corresponds to the profile of the master's degree program, according to which the master's thesis is being performed and defended;

2) relevant and contains scientific novelty and practical significance;

3) based on modern theoretical, methodological and technological achievements of science and practice;

4) performed using modern methods of scientific research;

5) contains research (methodological, practical) sections on the main protected provisions;

6) is based on the best international experience in the relevant field of knowledge.

6.3 Requirements for the organization of practices:

The educational program of the scientific and pedagogical Master's degree includes two types of practices that are conducted in parallel with theoretical training or in a separate period:

1) pedagogical in the BD cycle - at the university;

2) research in the PD cycle - at the place of completion of the dissertation.

Pedagogical practice is conducted in order to form practical skills of teaching and learning methods. At the same time, undergraduates are involved in conducting undergraduate classes at the discretion of the university.

The research practice of the undergraduate is conducted in order to familiarize himself with the latest theoretical, methodological and technological achievements of domestic and foreign science, modern methods of scientific research, processing and interpretation of experimental data.

7 Appendix to the diploma according to the ECTS standard

The application is developed according to the standards of the European Commission, the Council of Europe and UNESCO/SEPES. This document serves only for academic recognition and is not an official confirmation of the document of

education. It is not valid without a higher education diploma. The purpose of filling out the European Application is to provide sufficient data about the diploma holder, the qualification he received, the level of this qualification, the content of the training program, the results, the functional purpose of the qualification, as well as information about the national education system. The application model, according to which the estimates will be translated, uses the European Credit Transfer or Credit Transfer System (ECTS).

The European diploma supplement provides an opportunity to continue education at foreign universities, as well as to confirm national higher education for foreign employers. When traveling abroad, additional legalization of the diploma of education will be required for professional recognition. The European diploma supplement is completed in English upon individual request and is issued free of charge.

Master's degree, level 7 of the national qualifications framework with the right to hold the following positions: Technical Director, Development Director, chief mechanic, chief power engineer at mining and metallurgical enterprises, according to the *Industry Qualifications Framework "Mining and Metallurgical Industry"* dated August 16, 2016 No. 1 of the Association of Legal Entities "Republican Association of Mining and Metallurgical Enterprises".

English language (professional)
CODE – LNG210
CREDIT – 5
PREREQUISITE – Academic English, Business English, IELTS 5.0-5.5

PURPOSE AND OBJECTIVES OF THE COURSE
The aim of the course is to develop students' knowledge of English for their current academic research and to improve the effectiveness of their work in the field of project management.

BRIEF DESCRIPTION OF THE COURSE
The course is aimed at developing vocabulary and grammar for effective communication in the field of project management and improving reading, writing, listening and speaking skills at the Intermediate level. It is expected that students will acquire and replenish their vocabulary of business English and study grammatical structures that are often used in the context of management. The course consists of 6 modules. The 3rd module of the course ends with an intermediate test, and the 6th module is followed by a test at the end of the course. The course ends with a final exam. Undergraduates also need to study independently (MIS). MIS - independent work of undergraduates under the guidance of a teacher.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After successful completion of the course, students are expected to be able to recognize the main idea and the main message, as well as specific details when listening to monologues, dialogues and group discussions in the context of business and management; understand written and oral speech in English on topics related to management; write management texts (reports, letters, emails, minutes of meetings), following the generally accepted structure with a higher degree of grammatical accuracy and using business words and phrases, talk about various business situations, using the appropriate business vocabulary and grammatical structures - in pair and group discussions, meetings and negotiations.

Management psychology
CODE – HUM208
CREDIT – 3
PREREQUISITE

PURPOSE AND OBJECTIVES OF THE COURSE
The main purpose of the course is aimed at studying the characteristics of the behavior of individuals and groups of people within organizations; determining psychological and social factors influencing the behavior of employees. Also, much attention will be paid to the issues of internal and external motivation of people. The main goal of the course is to apply this knowledge to improve the efficiency of the organization.

BRIEF DESCRIPTION OF THE COURSE
The course is designed to provide balanced coverage of all the key elements that make up the discipline. It will briefly examine the origin and development of the theory and practice of organizational behavior, and then will examine the main roles, skills and functions of management with an emphasis on management effectiveness, illustrated by real-life examples and case studies.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
At the end of the course, students will know: the basics of individual and group behavior; basic theories of motivation; basic theories of leadership; concepts of communication, conflict management and stress in the organization; will be able to identify various roles of managers in organizations; look at organizations from the point of view of managers; understand how effective management contributes to an effective organization.

Engineering calculations in metallurgy
CODE – MET235
CREDIT – 5
PREREQUISITE –

PURPOSE AND OBJECTIVES OF THE COURSE
Study of engineering calculations in metallurgy.

BRIEF DESCRIPTION OF THE COURSE
According to the discipline, methods of thermodynamic, mass transfer and technological calculations in the production of non-ferrous metals are studied, including: issues of choosing a technological scheme and basic metallurgical aggregates; drawing up material and thermal balances; plotting balance sheets; plotting dependency graphs and diagrams. Examples of drawing up algorithms for engineering calculations in metallurgy, drawing up flowcharts and programs using Excel and object-oriented programming languages are considered. Algorithms and programs for planning experiments and processing experimental data are studied.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After mastering this discipline, a master's student should:
know: methods of thermodynamic, mass transfer and technological calculations in the production of non-ferrous metals.
be able to: make flowcharts and programs, algorithms for engineering calculations.

Theory of mineral processing processes
CODE – MET757
CREDIT – 5
PREREQUISITE –

PURPOSE AND OBJECTIVES OF THE COURSE
Purpose: acquisition by undergraduates of in-depth knowledge on the theory of metallurgical processes: pyro-, hydro- and electrometallurgy; on the prospects for the development of theory, on the practical use of theoretical provisions.
Objectives of the discipline: obtaining knowledge by undergraduates about the structure and properties of slags, the features of hydrometallurgical and electrometallurgical processes; the ability to apply theoretical knowledge to analyze specific metallurgical systems and use this knowledge to solve specific technological problems.

BRIEF DESCRIPTION OF THE COURSE.
The article presents: systematized materials on oxide melts, the structure and properties of slags, as well as the theoretical foundations of hydrometallurgical and electrometallurgical processes, in-depth knowledge of methods for analyzing diagrams of the state of slag systems, diagrams "Potential - pH", patterns of electrometallurgical processes, as well as the basic laws of thermodynamics, mechanism and kinetics of the main metallurgical processes; examples of various processes of processing pyro - and hydro-electrometallurgical methods; methods and examples of application of software materials for thermodynamic and kinetic analysis of processes.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
Knowledge: basic laws of thermodynamics, mechanism and kinetics of the main metallurgical processes; skills in performing calculations on thermodynamics and kinetics of various metallurgical processes.
Skills and abilities: the ability to analyze existing and projected processes; predict the indicators of certain specific processes and directions of development of technologies for processing ore and man-made raw materials; estimating the speeds of individual stages of metallurgical processes, identifying speed-limiting links of simple and complex processes; skills in performing calculations on thermodynamics and kinetics of metallurgical processes, substantiating the choice of processes and requirements for their hardware design, forecasting indicators of certain specific processes and directions of development of technologies for processing ore and man-made raw materials; assessing the speed of individual stages of metallurgical processes, identifying speed-limiting links of simple and complex processes, calculating equipment for hydrometallurgical processes.

History and philosophy of science
CODE – HUM210
CREDIT – 4
PREREQUISITE –

PURPOSE AND OBJECTIVES OF THE COURSE
To reveal the connection between philosophy and science, to highlight the philosophical problems of science and scientific cognition, the main stages of the history of science, the leading concepts of philosophy of science, modern problems of the development of scientific and technical reality

BRIEF DESCRIPTION OF THE COURSE
The subject of philosophy of science, dynamics of science, specifics of science, science and pre-science, antiquity and the formation of theoretical science, the main stages of the historical development of science, features of classical science, non-classical and post-non-classical science, philosophy of mathematics, physics, engineering and technology, specifics of engineering sciences, ethics of science, social and moral responsibility of a scientist and engineer.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
To know and understand the philosophical issues of science, the main historical stages of the development of science, the leading concepts of the philosophy of science, to be able to critically evaluate and analyze scientific and philosophical problems, to understand the specifics of engineering science, to possess the skills of analytical thinking and philosophical reflection, to be able to justify and defend their position, to master the techniques of discussion and dialogue, to possess the skills of commutativity and creativity in their professional activities.

Higher school pedagogy
CODE – HUM209
CREDIT – 4
PREREQUISITE

PURPOSE AND OBJECTIVES OF THE COURSE
The course is aimed at studying the psychological and pedagogical essence of the educational process of higher education; forming ideas about the main trends in the development of higher education at the present stage, considering the methodological foundations of the learning process in higher education, as well as psychological mechanisms that affect the success of learning, interaction, management of subjects of the educational process. Development of psychological and pedagogical thinking of undergraduates.

BRIEF DESCRIPTION OF THE COURSE
In the course of studying the course, undergraduates get acquainted with the didactics of higher education, forms and methods of organizing education in higher school, psychological factors of successful learning, features of psychological impact, mechanisms of educational influence, pedagogical technologies, characteristics of pedagogical communication, mechanisms for managing the learning process. They analyze organizational conflicts and ways to resolve them, psychological destructions and deformations of the teacher's personality.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
At the end of the course, a master's student should know the features of the modern system of higher professional education, the organization of pedagogical research, the characteristics of the subjects of the educational process, the didactic foundations of the organization of the learning process in higher education, pedagogical technologies, patterns of pedagogical communication, the features of educational influences on students, as well as the problems of pedagogical activity.

Technologies and processes of distillation and condensation in metallurgy
CODE – MET242
CREDIT – 5
PREREQUISITE – MET757

PURPOSE AND OBJECTIVES OF THE COURSE
Familiarization with modern methods of rectification and condensation of metals, acquisition of skills for solving specific problems in the technology of rectification and condensation of metals with a wide application of the fundamentals of physical chemistry and pyrometallurgical processes.

BRIEF DESCRIPTION OF THE COURSE
Rectification is the separation of liquid mixtures into practically pure components that differ in boiling points by performing multiple operations of liquid evaporation and vapor condensation. Familiarization with the theory and practice of rectification and condensation processes. Constructions of new tower column apparatuses equipped with contact devices (plates or nozzle) - rectification columns, in which repeated contact is carried out between the streams of steam and liquid phases. Methods of rectification and their features. Continuous and/or periodic methods of rectification, their application. Features of rectification of binary (two-component) and multicomponent mixtures.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
Knowledge of the theory and technology of the processes of distillation, rectification and condensation of metals. Acquisition of skills for solving specific problems in the technology of obtaining rare, rare-earth metals. Skills and abilities (professional, managerial, communicative) to analyze modern technological processes of distillation, distillation and condensation. Acquisition of skills in the organization of technological processes, the ability to solve non-standard tasks, the search for new solutions for technology and aggregates for the complex extraction of rare and rare earth metals in various ways.

Current and future technology for the processing of ore and technogenic raw materials
CODE – MET263
CREDIT – 5
PREREQUISITE – MET757

PURPOSE AND OBJECTIVES OF THE COURSE
Mastering the modern level of engineering knowledge by undergraduates in the field of advanced technologies for processing ore and man-made raw materials. To provide training of a specialist with a deep understanding of the physico-chemical foundations and technological practice of enrichment processes, pyro- and hydrometallurgy.

BRIEF DESCRIPTION OF THE COURSE
In this discipline, environmentally safe processes of complex processing and opening of difficult-to-enrich ores and man-made deposits are studied on the basis of combining modern methods of enrichment, pyro- and hydrometallurgy with the use of additional energy influences.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
Knowledge about the raw materials of Kazakhstan, about possible ways of rational processing of raw materials, about the characteristics of the classification of production waste, about technologies for processing substandard and man-made raw materials and production waste in the country and abroad. Be able to find optimal solutions to the problem in the context of complex processing of raw materials, analyze a particular situation related to the disposal of industrial waste, justify the choice of the proposed technology for processing substandard raw materials, give a metallurgical and economic assessment of little-used raw materials.

Technology and refining of radioactive metals
CODE – MET759
CREDIT – 5
PREREQUISITE – MET757

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: Formation of knowledge about the theoretical laws and practice of refining methods in the production of radioactive metals.
Objectives of the course: to transfer the basic theoretical knowledge of the course; to help students gain skills in performing practical work; to familiarize them with the basic technological schemes of various purification methods in the production of radioactive metals, their principles and capabilities, prospects and limitations.

BRIEF DESCRIPTION OF THE COURSE
The course provides theoretical patterns and practice of the main processes of refining radioactive metals (uranium, thorium and plutonium). Sedimentation and extraction methods of purification in uranium technology; refining of uranium oxide from "yellow cake" and commercial desorbates; Technology and hardware design of purification of thorium compounds (fractional neutralization method, hydrated thorium sulfate precipitation method, oxalate and extraction purification methods); as well as thorium and uranium separation methods. Technology and hardware design of plutonium refining: precipitation and "dry" separation schemes of uranium and plutonium, extraction schemes with organic solvents.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students should
know: the principles of hardware and technological design of the main and auxiliary technological processes and operations of refining radioactive metals;
be able to: choose and justify the refining scheme of a specific radioactive metal; make material balances of refining devices;
possess the skills of: comparative analysis of various refining methods; application of refining methods in solving practical problems.

Technology and refining of precious metals
CODE – MET758
CREDIT – 5
PREREQUISITE – MET757

PURPOSE AND OBJECTIVES OF THE COURSE
Formation of knowledge about the theoretical laws and practice of refining methods in the production of precious metals.
Objectives of the course: to transfer the basic theoretical knowledge of the course; to help students gain skills in performing practical work; to familiarize them with the basic technological schemes of various refining methods in the production of precious metals, their principles and capabilities, prospects and limitations.

BRIEF DESCRIPTION OF THE COURSE.
Refining of gold and silver. Raw materials and their preparation for refining, chlorine process, refining by electrolysis, acid refining methods. Losses and entrainment of gold and silver during refining of precious metals. Entrainment of gold and silver with waste gases, irretrievable losses of precious metals during refining, processing of production waste. Refining of MPG (platinum group metals). Raw materials for the production of platinum metals, processing of platinum dressing: dissolution and refinement of solutions, processing of masterbatch solutions. Obtaining rhodium and iridium. Obtaining osmium and ruthenium. Processing of waste refining of platinum dressing.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students should
know: the principles of hardware and technological design of the main and auxiliary technological processes and operations of refining of precious metals and MPG (platinum group metals);
be able to: choose and justify the refining scheme, make up the material balances of refining devices;
possess the skills of: comparative analysis of various refining methods; application of refining methods in solving practical problems.

Current and future technologies for processing raw materials of ferrous and nonferrous metallurgy
CODE – MET752
CREDIT – 5
PREREQUISITE – MET757

PURPOSE AND OBJECTIVES OF THE COURSE
Study of methods of extraction and processing of ferrous, non-ferrous, rare and precious metals by their selective dissolution by chemical reagents at the site of occurrence and subsequent extraction of chemical compounds formed in the reaction zone.

BRIEF DESCRIPTION OF THE COURSE
The characteristics of the raw material base of ferrous and non-ferrous metallurgy are considered, the features of the material composition of ferrous and non-ferrous metals ores are considered, technological schemes and modes are described, the issues of ore preparation for enrichment from the early stages of mining production are disclosed, optimal conditions for ore pre-concentration are indicated, ensuring an increase in the complexity of the use of raw materials in the mining process and during enrichment. In addition, the principles of the organization of production and prospects for the development of technology and technology for the enrichment of ores of ferrous and non-ferrous metals are outlined.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After mastering this discipline, a master's student should:
know: types of ores and deposits of ferrous and non-ferrous metals, characteristic features of ores of ferrous and non-ferrous metals, the influence of the material composition of ores on enrichment indicators, technological requirements for the quality of ores entering for enrichment.
be able to: work with literature and analyze modern and promising technologies for processing raw materials of ferrous and non-ferrous metallurgy.

Special methods of hydrometallurgy
CODE – MET760
CREDIT – 5
PREREQUISITE – MET757

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: the acquisition by undergraduates of knowledge and skills in the field of technology for processing ore and man-made raw materials with solutions of alkaline reagents and ammonia.

BRIEF DESCRIPTION OF THE COURSE
Thermodynamic probability of leaching reactions of mineral raw materials with alkaline reagents. Kinetics of the leaching process. The state of metals in solutions of hydroxyl reagents. Technological features of alumina production by hydro-alkaline method. Organization of associated extraction of vanadium and gallium in the processing of alumina-containing raw materials. Ammonia hydrometallurgy. Equilibrium of complexation in aqueous-ammonia solutions. Physico-chemical prerequisites for the use of mixed solutions of sodium hydroxide and ammonia as leaching reagents. Hardware design of leaching processes. Examples of industrial use of hydro-alkaline processing of mineral and man-made raw materials. Some technological aspects and prospects for the development of ammonia hydrometallurgy.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, undergraduates should be able to conduct a thermodynamic assessment of the probability of leaching reactions of mineral raw materials with alkaline reagents. To know the nature of complex formation in ammonia media. Based on the calculation of the equilibrium constant of the reaction of the formation of an ammonia metal complex, to establish the degree of its stability. To understand the features of the hardware design of the processes of hydro-alkaline metallurgy; apply the acquired knowledge when carrying out calculations of equipment in the design of the proposed technological schemes for processing mineral and man-made raw materials.

Innovation in material science
CODE – PHY276
CREDIT – 5
PREREQUISITE –

PURPOSE AND OBJECTIVES OF THE COURSE
Formation of students' knowledge base based on planning and conducting scientific experiments, the use of innovative technologies and information sources; Students should have general information about the scientific foundations of materials science and methods of materials research, metals and alloys. To know the methods of production of ferrous and non-ferrous metals, the basics of metal science and heat treatment, the latest methods of obtaining nanomaterials, industrial use of basic structural and tool materials, methods of their mechanical and electrophysical processing. Electrophysical and electrochemical processing methods: electroerosion treatment, electric spark treatment, electric pulse treatment, electromechanical treatment, radiation treatment, surface electrochemical treatment, dimensional electrochemical treatment.

BRIEF DESCRIPTION OF THE COURSE
The course introduces modern scientific ideas about materials, the influence of micro– and nano-scale on the properties of materials, the interaction of materials with the environment, electromagnetic radiation and particle flows. The study of ferrous and non-ferrous metals and their alloys and non-metallic materials, the basics of the theory of heat treatment of metals. Types of heat treatment of metals: annealing, quenching, normalization, tempering, cryogenic treatment. The main technologies for obtaining nanomaterials are: vacuum technologies in the production of semiconductor structures, the method of molecular beam epitaxy (MPE), the gas-phase method of growing epitaxial films, chemical methods of coating formation, hydrothermal synthesis, sol-gel method, precipitation from solution.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students must master the terminology, basic concepts and definitions of the discipline; structural features of structural metals, non-metallic materials and other types of materials, the dependence of their properties on the structure and composition; the physical essence of the phenomena occurring in materials under external influences and operation. To know modern scientific achievements in the field of metal science, the main problems of the introduction of innovative technologies in the creation of new materials and methods of their processing. To know the basic modern technologies for the creation of nanomaterials, to apply modern technologies in the creation of nanoscale film structures, to understand the main features of electrical, optical and structural properties of nanomaterials. To determine the mechanical properties of structural materials; to evaluate changes in the mechanical properties of materials by methods of external influences: plastic deformation, heat treatment; to have an idea of promising directions for the creation of new structural materials.

Mass transfer in heterophase metallurgical systems
CODE – MET761
CREDIT – 5
PREREQUISITE – MET752, MET760

PURPOSE AND OBJECTIVES OF THE COURSE
Purpose: to provide knowledge about the transfer of matter (mass) within one phase and (or) between different phases.
Tasks: to evaluate the throughput and limiting stages for mass transfer processes; to determine concentrations, equilibrium, kinetics of mass transfer in the phase.

BRIEF DESCRIPTION OF THE COURSE
Basic concepts and general characteristics of mass transfer, its types and stages. Systems: gas-liquid, steam-liquid, liquid-liquid, liquid-solid, solid-solid. Calculation of mass transfer and mass transfer coefficients. Concentrations, ways of expressing the composition of phases and recalculation. Scheme of concentration distribution in phases during mass transfer. Kinetics of mass transfer in the phase. Material balance and mass transfer equation. Mass transfer at the level of the reaction volume. The average driving force, its calculation. The number of transfer units. The height of the transfer unit. Molecular diffusion. Turbulent diffusion. Convective transfer. Flows of matter, forward and countercurrent motion. Throughput and limiting stages of mass transfer. Step counterflow, graphoanalytical and analytical calculations. Mass transfer during the cross-connection of devices in the network. Periodic and semi-continuous processes. Mass transfer with solids.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
Knowledge: basic concepts and ratios of mass transfer, regularities of substance transfer in heterophase systems.
Skills and abilities: calculate the average driving force of mass transfer processes, mass transfer and mass transfer coefficients, make up the material balance of mass transfer processes, build working and equilibrium mass transfer lines.

Special chapters of extractive metallurgy (in English)
CODE – MET762
CREDIT – 5
PREREQUISITE – MET752, MET760

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: The formation of systematic knowledge among undergraduates about the basics and principles of extractive metallurgy, methods of processing raw materials, obtaining strategic, critical metals, innovative, modern technologies for extracting metals from raw materials.
The objective of the course: to give undergraduates the following knowledge in English:
about phase transformations and prediction of the properties of metals; about the rate of chemical reactions during metallurgical processing, about the importance and types of strategic, critical raw materials, about modern technologies for obtaining metals, about metallurgical technologies of the "green economy".

BRIEF DESCRIPTION OF THE COURSE
The course examines the role of extractive metallurgy in the mining and metallurgical sector. Thermodynamics of metallurgical processes. Phase diagrams, phase transformations and prediction of metal properties. Measurement and evaluation of the physical properties of metals at high temperatures. Transport phenomena and properties of metals. Kinetics of metallurgical reactions. Thermoanalytical methods of metal processing. Critical, strategic raw materials of extractive metallurgy. Complex processing of mineral, resistant raw materials. Pyrometallurgical processing of critical raw materials. Innovative technologies of pyrometallurgical processing of metals. Obtaining cobalt. Electrochemical processes in metallurgy. Obtaining magnesium, hafnium. Innovative technologies of hydrometallurgical processing of raw materials. Processing of raw materials containing rare and rare earth metals. Understanding the methods of obtaining rare metals (beryllium, bismuth, galium, niobium, etc.). Complex unconventional raw materials, man-made waste and secondary resources as sources of functional materials.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students must
1) know: thermodynamics and kinetics of metallurgical processes as the basis for technology development. advanced technologies of complex and deep processing of natural and man-made mineral raw materials. technological and environmental aspects of complex processing of difficult-to-enrich mineral and man-made raw materials of Kazakhstan. complex unconventional raw materials, man-made waste and secondary resources as sources of functional materials. technological problems of complex processing of rare-metal-rare-earth ores and ways to solve them.
2) be able to: perform calculations on thermodynamics and kinetics of metallurgical processes, perform technological calculations of mineral processing, structural calculations of mineral processing units;
3) possess the skills of: the algorithm for calculating the technological regulations of the technology, taking into account the technical terminology in English.

Electrolysis of water and non-water media
CODE – MET305
CREDIT – 5
PREREQUISITE – MET752, MET760

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: The formation of knowledge on the basics of electrometallurgical and electrochemical processes and skills of their application in metallurgy.
Course objective: to transfer basic theoretical knowledge on the course of electrolysis occurring in aqueous and non-aqueous media and molten salts; to help students gain skills of experimental work in the field of anodic dissolution and electrolytic separation of metals from aqueous solutions; to teach students to solve typical tasks on electrolytic separation of metals at the cathode; to form students' informal thinking skills in the field of electrometallurgical processes.

BRIEF DESCRIPTION OF THE COURSE
The course "Electrolysis of a water and non-water media" examines the laws, theoretical provisions and examples of practical application of electrolysis in metallurgical practice.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, students should
know: basic electrochemical laws, concepts and patterns of electrochemical reactions of dissolution and deposition of metals, basic technological techniques that allow applying electrochemical processes in metallurgical practice.
be able to: solve electrolysis problems using the acquired knowledge, paint the equations of electrochemical reactions, make technological calculations using the basic electrochemical patterns.
possess the skills: to navigate the basic concepts of electrolysis; to acquire the skills of experimental anodic dissolution and electrolytic deposition of metals from aqueous media.

Recycling technologies in ferrous and non-ferrous metallurgy
CODE – MET281
CREDIT – 5
PREREQUISITE – MET752, MET760

PURPOSE AND OBJECTIVES OF THE COURSE
Mastering by undergraduates of the modern level of engineering knowledge in the field of recycling technologies in ferrous and non-ferrous metallurgy. Preparation of undergraduates to work at enterprises, research institutes and laboratories related to the recycling of metallurgical waste.

BRIEF DESCRIPTION OF THE COURSE
Most of the metallurgical waste is stored in storage facilities near populated areas, which poses a threat to soil and water pollution and harms the health of residents and the environment as a whole. With the growing trend towards stricter environmental requirements, the issue of rational use and recycling of waste and slags generated in metallurgical production is acute. In this regard, the study of the theory and practice of modern processes of recycling of metallurgical waste, which represent the disposal of metallurgical enterprises from accumulated and generated industrial waste with the possibility of recycling of processed products, is the main focus of this course. Considering that waste from metallurgical production is a valuable raw material for obtaining by-products or for reuse in the technological process, in this course special attention will be paid to new recycling processes, the use of which is of great interest to the existing large metallurgical plants of Kazakhstan.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
Acquisition of knowledge in the field of theory and practice of recycling technologies, the ability to solve specific tasks. The skills and abilities (professional, managerial, communicative) acquired during the course of the discipline will be used to conduct a comparative analysis and select the most effective modern technological schemes.

Processes and production of high-purity metals
CODE – MET239
CREDIT – 5
PREREQUISITE – MET752, MET760

PURPOSE AND OBJECTIVES OF THE COURSE
Theoretical foundations of modern methods of obtaining ultrapure metals, widely used in the field of high technologies, acquisition of skills for solving specific problems in the technology of obtaining especially pure non-ferrous metals.

BRIEF DESCRIPTION OF THE COURSE
The global development of electronics, semiconductor devices and other areas in the field of high technology causes a great need for multifunctional materials of high purity. The use of especially pure metals determines the growth of the economic efficiency of their use: functionality is expanded, operational characteristics are improved.
Methods and new technologies for obtaining ultrapure metals. The main factors affecting the purification of metal from impurities. Physico-chemical processes occurring during the purification of metals from impurities. Properties of the base metal – melting point, electrical and thermal conductivity, surface tension of the liquid metal (for some variants of the organization of zone melting), chemical activity of metal and impurity elements, diffusion coefficients of impurity elements in liquid and solid metal, etc.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
Acquisition of knowledge of the theory and technology of the processes of production of ultrapure metals, the ability to solve specific problems in the technology of obtaining ultrapure metals. The skills and abilities (professional, managerial, communicative) acquired during the course of the discipline will be used to conduct a comparative analysis and select the most effective modern technological processes for the production of especially pure metals. The acquired knowledge and skills will be used in the organization of technological processes and solving non-standard tasks, as well as for the search and selection of new solutions in the development of technology and equipment for the production of high-purity metals

Technologies for extracting metals from slags
CODE – MET243
CREDIT – 5
PREREQUISITE – MET752, MET760

PURPOSE AND OBJECTIVES OF THE COURSE
The study of the theory and modern technologies of metal extraction from slags, the acquisition of skills for solving specific problems in the technology of extraction of copper, lead, etc. metals from oxide and oxide-sulfide melts (slag, slag-matte melt).

BRIEF DESCRIPTION OF THE COURSE
Modern methods of processing accumulated and current slag waste. New processes of additional extraction of non-ferrous and valuable metals from slags. Characteristics of slags of non-ferrous and ferrous metallurgy, structural features, forms of finding non-ferrous and valuable metals in slags. Selection and justification of slag processing methods, economic analysis and assessment of their possible processing. Waste-free, environmentally friendly slag processing technologies with complex extraction of valuable metals and the use of demetallized silicate parts for the production of building materials.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
Knowledge of the theory and technology of non-ferrous metallurgy slag processing processes, acquisition of skills for solving specific tasks in the technology of extracting metals from slags. The skills and abilities (professional, managerial, communicative) acquired during the course of the discipline will be used to analyze modern technological processes of slag processing to obtain commercial products, acquire skills in organizing technological processes, the ability to solve non-standard tasks and in the search for new solutions for technology and aggregates for processing non-ferrous metallurgy slags.

Technology for fractional separation of metals from a vapor-gas mixture
CODE – MET250
CREDIT – 5
PREREQUISITE – MET752, MET760

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of teaching the discipline is to study the technology of fractional separation of metals from a vapor-gas mixture.

BRIEF DESCRIPTION OF THE COURSE
The main reactions occurring during the pyrometallurgical processing of mineral raw materials. Characteristics of vertebral processes. Equipment for sublimation and condensation of vapors of non-ferrous metals and their compounds. Fractional separation and condensation of vapors of volatile components.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
After mastering this discipline, a master's student should:
know: the main repartitions and equipment for fractional vapor separation;
be able to: carry out technological calculations and select technological modes for the fractional separation of metals from a vapor-gas mixture.

Chlorine and vacuum technologies in metallurgy
CODE – MET283
CREDIT – 5
PREREQUISITE – MET752, MET760

PURPOSE AND OBJECTIVES OF THE COURSE
Study of the theory and technology of chlorination and vacuum metallurgy processes, acquisition of skills for solving specific problems of chlorination and vacuum technology for obtaining non-ferrous and rare metals. Hardware design of chlorination and vacuum technology, their features and disadvantages.

BRIEF DESCRIPTION OF THE COURSE
Modern methods of processing various raw materials using chlorine and vacuum technology. Characteristics of chlorides and thermodynamics of chlorination, forms of finding non-ferrous and valuable metals. Selection and justification of chlorine and vacuum technology in the processing of materials containing non-ferrous and precious metals, economic analysis and evaluation.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
Undergraduates will gain knowledge on the theoretical foundations of chlorine and vacuum technologies in metallurgy. Students will gain the ability to navigate a variety of processes and devices; perform technological heterophase circuits and choose equipment; be able to use scientific, technical and advertising literature for acquaintance and analysis of new technologies and devices.

Pedagogical practice
CODE – AAP244
CREDIT – 4
PREREQUISITE –

PURPOSE AND OBJECTIVES OF THE COURSE
Pedagogical practice sets its tasks:
- The use at a new level of theoretical knowledge in pedagogy, psychology and teaching methods obtained in the process of studying at the master's degree.
- Checking the degree of their readiness for independent scientific and pedagogical activity.
- Familiarization with new educational standards.

BRIEF DESCRIPTION OF THE COURSE
The application of modern scientific knowledge in the discipline in the educational process, the use of innovative technologies in the organization of the educational process.
Creating conditions for achieving professional competence in accordance with the requirements of the standard in the field of training.
Preparation for pedagogical activity in mining, metallurgical and oil and gas production. Creation of scientific and pedagogical educational programs related to modern tasks of mining, metallurgical and oil and gas production, for their use in scientific and scientific-technical universities and educational institutions.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
As a result of pedagogical practice , a master 's student must:
To know: the content of the current state educational standards; modern teaching methods;
Be able to: develop the subject and methodological content of training sessions for students of secondary, special and higher educational institutions; evaluate the effectiveness of educational activities;
Have the skills to: conduct classes in educational institutions; methodically competently build a plan of lectures (practical classes); public presentation of theoretical and practical sections of academic disciplines in accordance with approved teaching aids.

Research scientific training
CODE – AAP236
CREDIT – 7
PREREQUISITE –

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the research practice is: analytical review of scientific and patent literature on the subject of scientific research; acquisition of skills to work on modern scientific and/ or technological equipment used in the metallurgical industry; development of original scientific proposals and scientific ideas on the subject under study; obtaining skills of independent research work, as well as work as part of research teams.
The task of research practice is focused on the acquisition of skills and solutions of the following nature: to be able to analyze and critically evaluate the results of their own scientific research, as well as leading specialists and scientists in the relevant field of research in enrichment and metallurgy; to be able to identify scientific priorities, as well as formulate relevant scientific tasks and problems; to be able to justify and formulate the relevance, theoretical and practical significance of the chosen topic of scientific research; to develop and improve the ability to conduct independent research in accordance with the developed program.

BRIEF DESCRIPTION OF THE COURSE
The research practice of a master's student is conducted in order to get acquainted with the latest theoretical, methodological and technological achievements of domestic and foreign science, with modern methods of scientific research, processing and interpretation of experimental data, as well as the acquisition of research skills for professional activity.
The research practice of undergraduates is conducted in accordance with the approved academic calendar and the individual work plan of the undergraduate in the amount established by the relevant state mandatory standard of postgraduate education in the specialty.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
During the research practice, a master's student must:
study: sources on the topic being developed for use in the implementation of a master's thesis; special literature on the selected research topic, including domestic and foreign authors; research methods; methods of analysis and processing of experimental data; requirements for the design of a master's thesis and scientific and technical documentation.
to perform: a scientific experiment in accordance with the research work plan; collection, statistical processing, analysis and systematization of scientific information on the topic of the dissertation for writing a scientific article and preparing an analytical review and other chapters of the master's thesis; comparison of the results obtained with domestic and foreign studies; formulation of the main hypothesis, preliminary conclusions; analysis of the scientific, methodological and practical significance of the research; preparation of a master's thesis on the basis of collected, generalized and scientifically processed information.

Master's student scientific research, including an internship and a master's thesis.
CODE – AAP242
CREDIT – 6
PREREQUISITE –

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the research work is to prepare a master's student, both for independent research work, the main result of which is the writing and successful defense of a master's thesis, and for conducting scientific research as part of a creative team. The research work in the semester is carried out by a master's student under the supervision of a supervisor.
The objectives of the research work in the semester are to instill the skills of performing research work and the development of skills: to conduct bibliographic work with the involvement of modern information technologies; to formulate and solve problems arising during the execution of research work; to choose the necessary research methods (modify existing ones, develop new methods) based on the objectives of a specific study (on the topic of a master's thesis or when performing tasks of a supervisor within the framework of the (author's) master's program); apply modern information technologies in conducting scientific research; process the results obtained, analyze and present them in the form of completed research developments (research report, abstracts, scientific article, term paper, master's thesis); formalize the results of the work done in accordance with the requirements of regulatory documents with the involvement of modern editing and printing tools.

BRIEF DESCRIPTION OF THE COURSE
The list of forms of research work in the semester for undergraduates of the first and second year of study can be specified and supplemented depending on the specifics of the master's program. The head of the master's program establishes a mandatory list of forms of research work (including those necessary for obtaining credits for research work in the semester) and the degree of participation in the research work of undergraduates during the entire period of study.
The results of research work for each semester and for the entire period of study are drawn up in writing (report), approved by the supervisor and submitted to the graduating department. According to the results of the implementation of the research plan, the master's student is given a final assessment ("credited" / "not credited").
Undergraduates who have not submitted a report on research work on time and have not received a credit are not allowed to defend their master's thesis.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
The graduating department defines special requirements for the preparation of a master's student in the research part of the master's program, which include:
- knowledge of modern problems of this branch of knowledge;
- knowledge of the history of the development of a specific scientific problem, its role and place in the studied scientific direction;
- the presence of specific specific knowledge on the scientific problem studied by the undergraduate;
- the ability to practically carry out scientific research, experimental work in a particular scientific field related to the master's program (master's thesis).

Registration and defense of the master's thesis (RaDMT)
CODE – ECA205
CREDIT – 12
PREREQUISITE –

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the master's thesis is: to
demonstrate the level of scientific / research qualifications of a graduate student, the ability to independently conduct a scientific search, to test the ability to solve specific scientific and practical problems, knowledge of the most general methods and techniques for solving them.

BRIEF DESCRIPTION OF THE COURSE
A master's thesis is a final qualifying scientific work, which is a generalization of the results of an independent study by a master's student of one of the actual problems of a particular specialty of the relevant branch of science, having an internal unity and reflecting the progress and results of the development of the chosen topic.
The Master's thesis is the result of the research /experimental research work of the undergraduate conducted during the entire period of the undergraduate's studies.
The defense of a master's thesis is the final stage of master's degree preparation. The master's thesis must meet the following requirements–
- the work must conduct research or solve current problems in the field of non-ferrous and ferrous metallurgy;
- the work should be based on the identification of important scientific problems and their solution;
- decisions must be scientifically sound and reliable, have internal unity;
- the dissertation work should be written alone.

Content