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»

Educational program
7M07223 - "METALLURGY AND MINERAL PROCESSING"
Master of Technical Sciences

based on the following specialty that has lost the validity of the Classifier of the specialty: 6M073700 - Mineral processing

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. Director of the mining and metallurgical Institute named after O. A. Baykonurov _____ Rysbekov K.B.
3. 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. Chief concentrator of "KAZ Minerals" LLP _____ Dzhetybayeva U.K.

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 6M073700- "Mineral processing" 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;

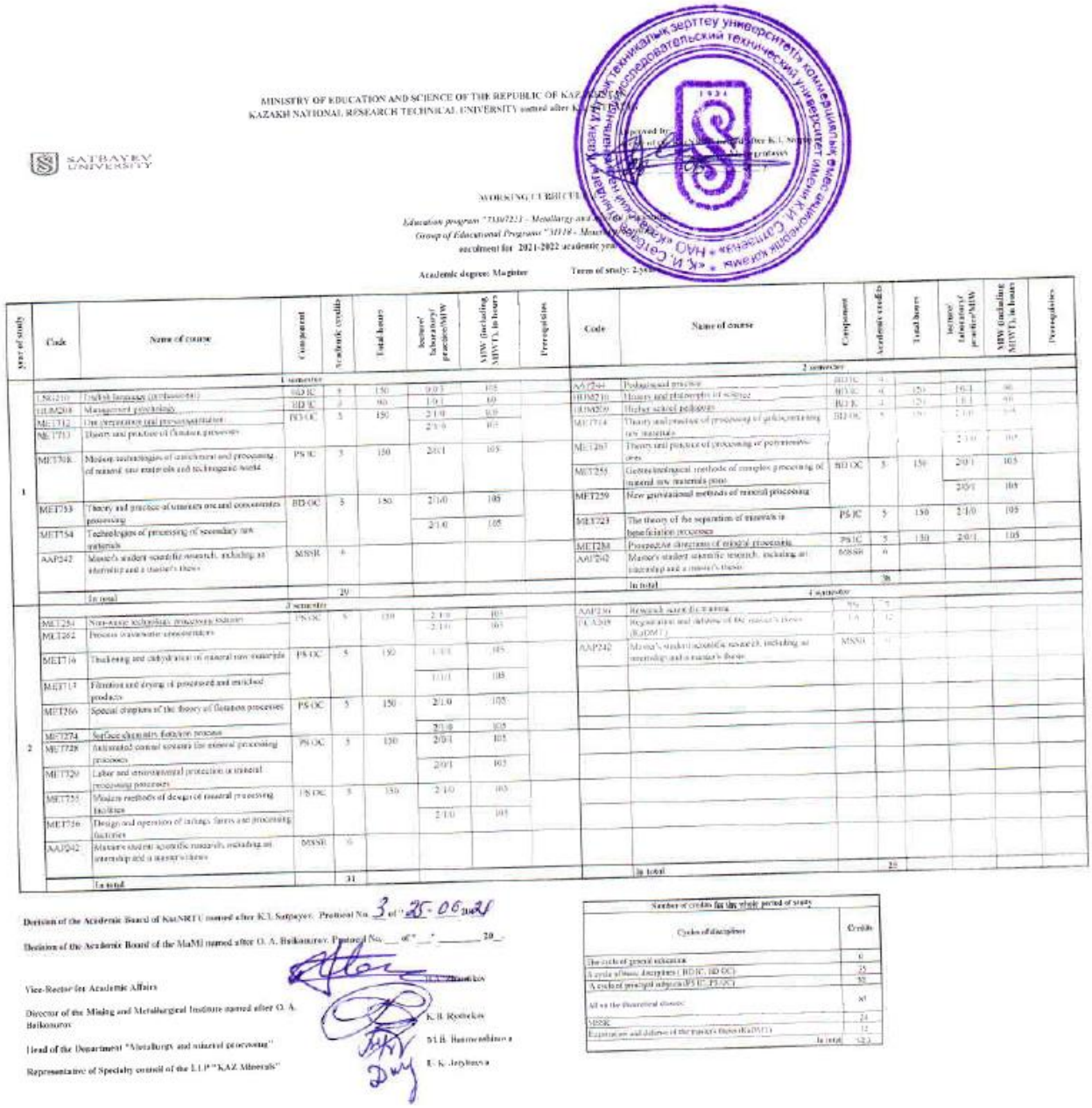
- scientific and pedagogical activity:

- 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 KAZ
KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I. Satpayev

SATBAYEV UNIVERSITY

WORKING CURRICULUM

Education program "7M07221 – Metallurgy and
Group of Educational Programs "M118 – Mine
enrollment for 2021-2022 academic ye

Academic degree: Magister Term of study: 2 ye

Year of study	Code	Name of course	Component	Academic credits	Total hours	lectures/ laboratory/ practice/MSW	MSW (including MSWT), in hours	Prerequisites
		1 semester						
1	LNG1210	English language (B1/Intermediate)	BD UC	5	150	0/0/3	105	
	HUM2018	Management (psychology)	BD UC	2	60	1/0/1	60	
	ME1712	The organization and research activities	BD OC	5	150	2/1/0	105	
	ME1713	Theory and practice of flotation processes				2/1/0	105	
	MET308	Modern technologies of geological and processing of mineral raw materials and technogenic waste	PS IC	5	150	2/0/1	105	
	MET753	Theory and practice of minerals and concentrates processing	BD OC	5	150	2/1/0	105	
	MET754	Technologies of processing of secondary raw materials				2/1/0	105	
	AAP242	Master's student scientific research, including an internship and a master's thesis	MSSR	6				
		In total		30				
		2 semester						
2	MET254	Non-metallic technology (processing features)	PS OC	5	150	2/1/0	105	
	MET262	Process wastewater concentrators				2/1/0	105	
	MET716	Thickening and dehydration of mineral raw materials	PS OC	5	150	1/1/1	105	
	MET713	Filtration and drying of processed and enriched products				1/1/1	105	
	MET266	Special chapters of the theory of flotation processes	PS OC	5	150	2/1/0	105	
	MET274	Surface phenomena: flotation process				2/1/0	105	
	MET728	Automated control systems for mineral processing processes	PS OC	5	150	2/0/1	105	
	MET729	Labor and environmental protection in mineral processing processes				2/0/1	105	
	MET725	Modern methods of design of mineral processing facilities	PS OC	5	150	2/1/0	105	
	MET726	Design and operation of tailings, dumps and processing factories				2/1/0	105	
	AAP242	Master's student scientific research, including an internship and a master's thesis	MSSR	6				
		In total		31				

Code	Name of course	Component	Academic credits	Total hours	lectures/ laboratory/ practice/MSW	MSW (including MSWT), in hours	Prerequisites
	2 semester						
AAP244	Pedagogical practice	BD UC	4	120	0/0/4	60	
HUM2010	History and philosophy of science	BD UC	4	120	1/0/1	60	
HUM2039	Higher school pedagogy	BD UC	5	150	2/1/0	105	
MET714	Theory and practice of processing of gold-containing raw materials	BD OC	5	150	2/1/0	105	
ME1267	Theory and practice of processing of polymetallic ores				2/0/1	105	
MET255	Geotechnological methods of complex processing of mineral raw materials mine				2/0/1	105	
MET259	New gravitational methods of mineral processing						
MET723	The theory of the separation of minerals in beneficiation processes	PS IC	5	150	2/1/0	105	
MET284	Prospective directions of mineral processing	PS IC	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						
AAP250	Research work (Dissertation)	MSC	15				
PLA205	Registration and defense of the master's thesis (RAPDM)	PLA	12				
AAP242	Master's student scientific research, including an internship and a master's thesis	MSSR	9				
	In total		36				

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 — K.B. Rodchenkov

Director of the Mining and Metallurgical Institute named after O. A. Baikonurov — S.I.B. Baimenshinova

Head of the Department "Metallurgy and mineral processing" — K.B. Rodchenkov

Representative of Specialty council of the LLP "KAZ Minerals" — E.K. Arzybaeva

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 UC, BD OC)	35
A cycle of principal subjects (PS IC, PS OC)	30
All on the theoretical classes	65
MSSR	24
Experience and defense of the master's thesis (RAPDM)	12
In total	120

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.

Ore preparation and pre-concentration
CODE – MET712
CREDIT – 5
PREREQUISITE

PURPOSE AND OBJECTIVES OF THE COURSE
- mastering the theory and practice of ore preparation processes of various types of mineral raw materials by undergraduates;
- mastering the theory and practice of the processes of preconcentration of various types of mineral raw materials by undergraduates;
- instilling skills of active use of technical literature in the study of the preparation and pre-concentration of ores.

BRIEF DESCRIPTION OF THE COURSE
In this course, the following are studied in detail: 1) technological processes of ore preparation (crushing, screening, grinding and classification); 2) technological processes of ore preconcentration (gravity, mechanized ore picking using X-ray-luminescent, X-ray radiometric, photometric enrichment, by natural radioactivity, selective crushing, enrichment by friction and shape); 3) apparatus and design of equipment for preparation and preconcentration.

KNOWLEDGE, ABILITIES, SKILLS AT THE END OF THE COURSE
Knowledge of the theory and technology of ore preparation and pre-concentration processes. Acquisition of skills for solving specific tasks in the technology of ore preparation of various types of mineral raw materials. Skills and abilities (professional, managerial, communicative) to analyze modern technological processes of preparation and pre-concentration of ores. Acquisition of skills in the organization of technological processes, the ability to solve non-standard tasks.

Theory and practice of flotation processes
CODE – MET713
CREDIT – 5
PREREQUISITE –

PURPOSE AND OBJECTIVES OF THE COURSE
Mastering by undergraduates of the modern level of engineering knowledge in the field of theory and practice of flotation processes. To provide training for a specialist with a deep understanding of the physico-chemical fundamentals and technological practice of flotation processes.

BRIEF DESCRIPTION OF THE COURSE
In this discipline, the following are studied: physico-chemical principles of flotation enrichment, types of flotation reagents, mechanisms of their action on the surface of minerals (types of adsorption, distribution over the surface of minerals), thermodynamic and kinetic patterns of particle adhesion to air bubbles, flotation technology, the role of particle sizes in flotation, machine designs and their features, flotation schemes and briefly about the technology of enrichment of various types of ores.

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE
Acquisition of knowledge in the field of theory and practice of flotation processes, the ability to solve specific problems in the technology of flotation processes. 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 and reagent flotation modes.

Modern technologies of enrichment and processing of mineral raw materials and technogenic waste
CODE – MET708
CREDIT – 5
PREREQUISITE –

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of teaching the discipline is to study new modern technologies for the enrichment and processing of mineral raw materials and man-made waste. The objectives of studying the discipline is to gain knowledge by undergraduates in the field of physical and physico-chemical fundamentals of the technology of processing mineral and man-made raw materials, as well as the modern equipment used in them that implements these technologies in production conditions.

BRIEF DESCRIPTION OF THE COURSE.
Schemes for the enrichment of sulfide ores. The complexity of the use of raw materials. Modes of flotation of sulfide ores. Modes of flotation of oxidized minerals of non-ferrous metal ores. Modes of flotation of salt-like minerals and metal oxides. Technology for extracting gold from stale tailings of enrichment. Cyanide technology for processing flotation tailings. Chloride technologies for processing technogenic raw materials. System analysis of flotation processes.

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE
After completing the course, the master's student must demonstrate the ability to analyze the material passed on the basis of modern enrichment and hydrometallurgical technologies used in the processes of mineral and man-made raw materials enrichment. The master

Theory and practice of uranium ore and concentrates processing
CODE – MET753
CREDIT – 5
PREREQUISITE –

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of studying the discipline is: mastering by undergraduates the theory and practice of methods for extracting uranium from poor and off-balance ore raw materials; training specialists of concentrators capable of most efficiently carrying out technological processes for enriching uranium-containing ores and concentrates, as well as conducting research on these processes.
The objectives of studying the discipline: obtaining knowledge by undergraduates in the field of enrichment and processing of uranium-containing ores and concentrates; performing calculation tasks; making design decisions.

BRIEF DESCRIPTION OF THE COURSE
The course is devoted to the study of technological processes of enrichment and processing of uranium ores, the design of the equipment used and methods of processing concentrates and productive solutions.

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE
As a result of studying the discipline, a master's student should:
know: spatial representation of the structures of devices;
be able to: navigate the processes of enrichment and processing of uranium ores, as well as technologies for processing concentrates and productive solutions; use scientific and technical literature for acquaintance and analysis of new technologies and devices.

Technologies of processing of secondary raw materials
CODE – MET754
CREDIT – 5
PREREQUISITE –

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the course: To form a systematic understanding of the theoretical foundations and technology of modern hydrometallurgical methods of complex extraction of metals from ore raw materials and metallurgical industrial products, to prepare a graduate student for independent work on the analysis of technological processes and the choice of methods for improving technology.
The objective of the course: the basic laws of thermodynamics, mechanism and kinetics of the main hydro - and electrometallurgical processes; to help students gain skills in performing laboratory work; to teach them to solve typical problems and paint reaction equations; which contributes to the informal assimilation of theoretical material.

BRIEF DESCRIPTION OF THE COURSE
The course examines the main processes and operations in hydrometallurgy. Theoretical foundations and technological schemes of leaching processes. Thermodynamics and kinetics of leaching processes. Non-oxidative and oxidative leaching of metallurgical raw materials. Hydro- and electrometallurgical processing of sulfide materials. Theory and practice of extraction and sorption processes. Fundamentals of the deposition processes of poorly soluble compounds. Fundamentals of hydro- and electrometallurgical processes. Thermodynamics of electrochemical processes in the processing of metallurgical raw materials and the production of metals.

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE
As a result of mastering the discipline, undergraduates should:
know: about the methods of intensification of hydro - and electrometallurgical processes, methods of critical analysis of the current level of technology; about the theoretical laws and practice of the main hydro - and electrometallurgical processes.
be able to: direct engineering efforts to create effective hydro- and electrometallurgical technologies. based on the analysis of the technological process, propose ways to improve the technology, choose methods for the implementation of the tasks; select and justify the hydrometallurgical scheme for processing specific metallurgical raw materials; based on the analysis of the technological process, propose ways to improve the technology, choose methods for the implementation of the tasks.
possess skills: skills of performing calculations on thermodynamics and kinetics of hydro- and electrometallurgical 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.

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.

Theory and practice of processing of gold-containing raw materials
CODE – MET714
CREDIT – 5
PREREQUISITE – MET708

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of the discipline is to develop professional competence among undergraduates in the field of theory and practice of processing gold-containing raw materials, modern technologies and equipment. The discipline program expands the basic knowledge of undergraduates on traditional and new technologies for extracting gold from various types of raw materials, and shows the possibility of applying knowledge in research, and production and technological activities.

BRIEF DESCRIPTION OF THE COURSE
In this discipline are studied: The material composition of gold ores. The technology of processing gold ores using processing and metallurgical operations. Refining. Associated extraction of gold in the processing of copper and zinc concentrates. Technologies for processing secondary raw materials containing precious metals. Environmental aspects in the processing of gold-containing raw materials.

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE
Undergraduates will gain knowledge on rational methods of processing gold-containing raw materials, depending on the composition of the source ore. Students will gain the ability to determine and evaluate the results of the enrichment of gold-containing raw materials, competently use the acquired knowledge when performing theoretical and experimental studies, hardware design of processes. Acquisition of skills in the organization of technological processes, the ability to solve non-standard tasks.

Theory and practice of processing of polymetallic ores
CODE – MET267
CREDIT – 5
PREREQUISITE – MET708

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of studying the discipline:
- Development of professional competence among undergraduates in the field of theory and practice of processing polymetallic raw materials, modern technologies and equipment;
- Preparation of undergraduates to work at enterprises, research institutes and laboratories related to the processing of polymetallic ores by flotation methods of enrichment, which are the main ones in the enrichment of polymetallic ores of non-ferrous metals.
The task of studying the discipline is to obtain theoretical and practical knowledge in the field of technological processes for processing polymetallic ores.

BRIEF DESCRIPTION OF THE COURSE
The main task to be solved when creating new technological processes for processing mineral raw materials is the development of resource-saving and environmentally friendly enrichment methods. Polymetallic ores, in which valuable components are minerals of lead, zinc, copper, precious metals, in some cases tin minerals are a very complex object for mechanical enrichment. The associated extraction of precious metals significantly affects the profitability of processing of this mineral raw material. The optimal method of processing polymetallic ores is flotation enrichment. The efficiency of the flotation process is primarily determined by the correct selection of reagents that ensure the production of high-quality selective concentrates of non-ferrous metals with minimal possible losses of metals in different-named concentrates and dump tailings.

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE
Undergraduates will gain knowledge on rational ways of processing polymetallic raw materials, depending on the composition of the source ore. Students will gain the ability to determine and evaluate the results of enrichment of polymetallic raw materials, competently use the acquired knowledge when performing theoretical and experimental studies, hardware design of processes. Acquisition of skills in the organization of technological processes, the ability to solve non-standard tasks.

Geotechnological methods of complex processing of mineral raw materials poor
CODE – MET255
CREDIT – 5
PREREQUISITE – MET708

PURPOSE AND OBJECTIVES OF THE COURSE
Development of professional competence among undergraduates in the field of geotechnological methods of complex processing of poor mineral raw materials, modern technologies and equipment. The discipline program expands the basic knowledge of undergraduates on traditional and new geotechnological methods of processing poor mineral raw materials, and shows the possibility of applying knowledge in research, and production and technological activities.

BRIEF DESCRIPTION OF THE COURSE
The discipline studies methods of geotechnological extraction of minerals, as well as characteristics of the properties of rocks and minerals, in order to determine the possibility of transferring extracted useful components to a mobile state. The issues of physico-chemical bases of geotechnological processes are considered. The schemes of geotechnological processing of uranium, gold, manganese, iron ores and non-metallic minerals are studied, and the processes of processing geotechnical products are also considered. The economic, environmental and social aspects of geotechnological methods of mineral enrichment are considered.

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE
Acquisition of knowledge in the field of theory and practice of geotechnological processes, 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.

New gravitational methods of mineral processing
CODE – MET259
CREDIT – 5
PREREQUISITE – MET708

PURPOSE AND OBJECTIVES OF THE COURSE
Mastering by undergraduates of the scientific foundations, theory and practice of gravitational processes of enrichment of various types of mineral raw materials. The discipline program expands the basic knowledge of undergraduates on traditional and new gravitational technologies for processing mineral raw materials, and shows the possibility of applying knowledge in research, and production and technological activities.

BRIEF DESCRIPTION OF THE COURSE
Theoretical foundations of classification processes, enrichment in heavy suspensions, deposition and enrichment in a stream of water flowing along an inclined surface, washing and pneumatic enrichment. Technological processes of gravity enrichment of various types of ores. Designs of new types of gravity equipment.

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE
Undergraduates will gain knowledge on the theoretical foundations of gravitational enrichment processes. Students will gain the ability to navigate the variety of processes and devices used in gravity enrichment; perform technological calculations of schemes and choose equipment for gravity enrichment; be able to use scientific, technical and advertising literature for acquaintance and analysis of new technologies and devices.

The theory of the separation of minerals in beneficiation processes
CODE – MET723
CREDIT – 5
PREREQUISITE – MET708

PURPOSE AND OBJECTIVES OF THE COURSE
Mastering the scientific foundations, theory and practice of mineral separation in the enrichment processes by undergraduates. The discipline program expands the fundamental knowledge of undergraduates on the methods and principles of processing mineral raw materials, and shows the possibility of applying knowledge in research, and production and technological activities.

BRIEF DESCRIPTION OF THE COURSE
The theoretical foundations, types and indicators of processing processes, patterns of separation of mineral particles in the working areas of processing machines and technological schemes, methods of modeling separation processes are considered. The issues of separation of minerals in the processes of ore enrichment are studied based on differences in the properties of the separated minerals. In this case, the difference in the physicochemical properties of the surface of minerals is used, namely, the difference in their specific free surface energies, separating media and their properties: density (specific gravity), viscosity, etc.

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE
As a result of studying the discipline the student must:
– to know the theory of disclosure of mineral phases; methods of fractionation of mineral raw materials with different separation characteristics; principles of drawing up the basic equations for different separation processes in the conditions of mass transfer; methods of obtaining separation characteristics and processes of experimental and theoretical way; the principles of the sharing schemes; classification of forces acting in working areas and processing apparatus;
- be able to represent and use enrichment and contrast curves to predict the maximum and theoretically possible enrichment indicators; evaluate the separation efficiency using separation characteristics of devices; forecast technological indicators; analyze the effectiveness of elements of enrichment technology; select and calculate the pre-enrichment scheme using information methods.

Prospective directions of mineral processing
CODE – MET284
CREDIT – 5
PREREQUISITE – MET708

PURPOSE AND OBJECTIVES OF THE COURSE
Familiarization of undergraduates with promising areas of development of technology and technology of processing and enrichment of minerals. The discipline program expands the basic knowledge of undergraduates on the methods and principles of processing mineral raw materials, and shows the possibility of applying knowledge in research, and production and technological activities.

BRIEF DESCRIPTION OF THE COURSE
Radiometric separation methods. Energy methods are microwave processing, electrohydrodynamic, magnetic pulse processing and powerful nanosecond pulses. Various methods of exposure to difficult-to-enrich mineral raw materials: ultrasonic treatment, mechanochemistry, electrochemical treatment. Industrial production of ultrasonic generators, electrochemical air conditioners, planetary mills. Biohydrometallurgical processing.

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE
Acquisition of knowledge in the field of promising areas of mineral processing, 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.

Non-waste technology processing industry
CODE – MET254
CREDIT – 5
PREREQUISITE – MET723, MET284

PURPOSE AND OBJECTIVES OF THE COURSE
Mastering by undergraduates of the scientific foundations, theory and practice of waste-free technologies for the enrichment of various types of mineral raw materials. The discipline program expands the basic knowledge of undergraduates on traditional and new waste-free technologies for processing mineral raw materials, and shows the possibility of applying knowledge in research, and production and technological activities.

BRIEF DESCRIPTION OF THE COURSE
In this discipline, such production methods will be studied that ensure the fullest possible use of the processed raw materials and the waste generated at the same time. The principles of waste-free technologies, requirements for waste-free production, the main directions of waste-free and low-waste technologies, waste recycling and use will be studied. Information is given on the processing of multi-tonnage dump waste from mining and processing plants with the release of ready-made building materials.

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE
Undergraduates will gain knowledge on the theoretical foundations of waste-free enrichment processes. Students will gain the ability to navigate a variety of processes and devices; perform technological calculations of circuits and choose equipment; be able to use scientific, technical and advertising literature to get acquainted and analyze new technologies and devices.

Process wastewater concentrators
CODE – MET262
CREDIT – 5
PREREQUISITE – MET723, MET284

PURPOSE AND OBJECTIVES OF THE COURSE
The purpose of teaching the discipline is to study the theoretical foundations and practice of wastewater treatment of processing plants, familiarization with reagents, equipment, and the design of devices used for these purposes. The objectives of studying the discipline is to gain knowledge by undergraduates on the formation and composition of wastewater from processing plants, methods of their transportation and laying in tailings, as well as on the operation of tailings, the practice of recultivation of disturbed lands, wastewater treatment and disposal of tailings during the processing of various types of mineral raw materials.

BRIEF DESCRIPTION OF THE COURSE
The course examines the current state of the water intake and spillway structures of the concentrating plant. Water consumption for technological needs in the enrichment processes. The composition of wastewater from processing plants, the liquid phase of tailings, filtrates, thickener drains, surface and stormwater. Polluted and conditionally clean wastewater from processing plants. The composition of wastewater from gravity, gold recovery and flotation processing plants. The main pollutants are coarse impurities, acids and alkalis, metal ions, organic reagents, cyanides, rhodonides, phenols and cresols, petroleum products, other flotation reagents. MPC of wastewater. Methods of wastewater treatment up to the maximum permissible MPC. Mechanical wastewater treatment. Neutralization. Neutralizer of alkaline wastewater with flue gases. Neutralization of alkaline wastewater with acid mine waters. Wastewater treatment from metal cations. Chemical oxidation method and chemical precipitation method. Wastewater treatment from petroleum products. Biological methods of purification. Circulating water supply of processing plants. Disposal of mineral processing waste

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE
After listening to this course, students should know the methods of wastewater treatment at processing plants, the design of equipment and apparatus used for the above methods. Be able to navigate the variety of methods, processes and devices used in the process of wastewater treatment. Have skills in choosing a wastewater treatment scheme.

Thickening and dehydration of mineral raw materials
CODE – MET716
CREDIT – 5
PREREQUISITE – MET723, MET284

PURPOSE AND OBJECTIVES OF THE COURSE
To form a system of knowledge about the technologies of thickening and dewatering of mineral raw materials necessary for the selection of a scheme for the preparation of a conditioned product suitable for subsequent processing: enrichment - metallurgical processes. Training of undergraduates in the techniques of competent use of technical reference books and equipment catalogs. Application of the acquired knowledge in daily work in production and in the organization of a productive production process in the field of thickening and dehydration of mineral raw materials.

BRIEF DESCRIPTION OF THE COURSE
The discipline contains the basics of the theory and mechanisms of the processes of dehydration of enrichment products and hydrometallurgy, dehydration processes in the presence of flocculants; introduces in detail the equipment and equipment used for these processes, the methodology of technological calculations of these processes.

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE
Knowledge of the laws of dehydration and thickening of mineral raw materials, methods of calculation of technological schemes of dehydration. To set a task and carry out scientific research in solving specific tasks in the field of training using modern equipment and computing tools; To simulate auxiliary processes occurring in minerals under external influences that allow changing the properties of mineral raw materials. It is necessary to understand the purpose of auxiliary operations in mineral processing technologies and familiarize yourself with their hardware design.

Filtration and drying of processed and enriched products
CODE – MET717
CREDIT – 5
PREREQUISITE – MET723, MET284

PURPOSE AND OBJECTIVES OF THE COURSE
To form a master's student's system of knowledge about the technologies of filtration and drying of enrichment products, solving problem situations when choosing optimal schemes for processing raw materials, taking into account its features.

BRIEF DESCRIPTION OF THE COURSE
The discipline contains the basics of the theory and mechanisms of the processes of dehydration of enrichment products and hydrometallurgy, dehydration processes in the presence of flocculants; introduces in detail the equipment and equipment used for these processes, the methodology of technological calculations of these processes.

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE
Knowledge of the laws of dewatering and thickening of mineral raw materials, methods for calculating technological schemes of dewatering, solving technological problems when choosing optimal schemes for processing mineral raw materials, taking into account its features.

Special chapters of the theory of flotation processes
CODE – MET266
CREDIT – 5
PREREQUISITE – MET723, MET284

PURPOSE AND OBJECTIVES OF THE COURSE
To form a system of knowledge about special chapters of the theory of flotation processes.
Training of undergraduates in the techniques of competent use of technical reference books and equipment catalogs. Application of the acquired knowledge in daily work in production and in the organization of a productive production process in the field of flotation processes.

BRIEF DESCRIPTION OF THE COURSE
This course outlines the theoretical foundations of the flotation process. The basic concepts of the flotation method of mineral raw material enrichment, the variety and complexity of physico-chemical processes occurring in the flotation pulp are given. The current state of the most pressing issues of flotation theory is described: preparation of minerals for flotation, interphase interactions, mechanism of action of flotation reagents, kinetics of flotation, etc. Attention is paid to new directions in the field of flotation: foam separation, ion and column flotation, electroflotation and the use of electrochemical technology. The possibility of solving the flotation problem based on the application of capillary physics equations is shown.

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE
Undergraduates will gain knowledge on the theoretical foundations of flotation enrichment processes. Students will gain the ability to navigate the variety of processes and devices used in flotation enrichment; perform technological calculations of schemes and choose equipment for flotation; be able to use scientific, technical and advertising literature for acquaintance and analysis of new technologies and devices. They will be able to use the acquired skills and knowledge for effective management of flotation
processes.

Surface chemistry flotation process
CODE – MET274
CREDIT – 5
PREREQUISITE – MET723, MET284

PURPOSE AND OBJECTIVES OF THE COURSE
To form a system of knowledge about the chemistry of surface phenomena of the flotation process. Training of undergraduates in the techniques of competent use of technical reference books and equipment catalogs. Application of the acquired knowledge in daily work on the flotation of mineral raw materials.

BRIEF DESCRIPTION OF THE COURSE
The universality of the flotation process is ensured by the fact that if the "natural" difference in the surface energy values of the separated minerals is small and insufficient for effective flotation separation, then it can be increased with the help of special reagents called flotation, the selective fixation of which on the surface of certain minerals changes their surface energy in a given direction. The parameters and properties of the phases of the flotation system and the main processes occurring during the interaction of phases in the volume of the liquid phase and on the mineral surface are described: hydration, dissolution and hydrolysis. The basic physico-chemical and flotation properties of collecting reagents and foaming agents, as well as the mechanism of their interaction with the mineral surface, are considered

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE
Undergraduates will gain knowledge on the main parameters and properties of the phases of the flotation system and the main processes occurring during the interaction of phases in the volume of the liquid phase and on the mineral surface: hydration, dissolution and hydrolysis. They will also know the general issues of the mechanism of adsorption of collecting reagents on minerals, taking into account the electrochemical heterogeneity and semiconductor properties of a solid. They will be able to use the acquired skills and knowledge for effective management of flotation processes.

Automated control systems for mineral processing processes
CODE – MET728
CREDIT – 5
PREREQUISITE – MET723, MET284

PURPOSE AND OBJECTIVES OF THE COURSE
To form a system of knowledge about the automated control of technological enrichment processes, including software modules used in algorithmic control software. Teaching undergraduates modern methods of "intelligent" management of enrichment processes.

BRIEF DESCRIPTION OF THE COURSE
Methods and means for analytical control of parameters of enrichment processes. Systems and means of organization of measurements, development and implementation of control actions. Automatic control of parameters and control of technological processes of enrichment. Modern methods of concentrating production management. Creation and implementation of automated process control systems at processing plants

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE
Undergraduates will gain knowledge on the theoretical foundations of automated control systems for mineral processing processes. They will be able to use the acquired skills and knowledge to effectively manage the processes of processing ore raw materials.

Labor and environmental protection in mineral processing processes
CODE – MET729
CREDIT – 5
PREREQUISITE – MET723, MET284

PURPOSE AND OBJECTIVES OF THE COURSE
Providing undergraduates with theoretical knowledge and practical skills necessary to solve issues related to ensuring safe working conditions during the development and use of new equipment and technological processes at the processing plant, the organization of production, excluding negative impacts on humans and the environment.

BRIEF DESCRIPTION OF THE COURSE
Sources of environmental pollution. Wastewater and recycled water treatment. Dust suppression and dust collection. Waste storage. Safety and industrial sanitation. Safety measures during maintenance of machines and mechanisms. Industrial injuries. Accident response plan.

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE
After studying the course, a master's student should know the legislative and regulatory documents on labor protection; duties and responsibilities of employers of enterprises and their departments to ensure healthy and safe working conditions for employees; methods and means of ensuring the regulatory values of the parameters of hazardous and harmful factors. A master's student should be able to identify dangerous and harmful production factors accompanying work at work; organize the solution of occupational safety issues at work.

Modern methods of design of mineral processing facilities
CODE – MET755
CREDIT – 5
PREREQUISITE – MET723, MET284

PURPOSE AND OBJECTIVES OF THE COURSE
Design of processing plants - to prepare a specialist for subsequent creative work in design institutes, organizations and in production, who has a deep understanding of the scientific principles and methods of design of processing plants.

BRIEF DESCRIPTION OF THE COURSE
The discipline studies general information about the design and design of mining and metallurgical enterprises, initial data for design, selection and justification of qualitative indicators of enrichment and productivity of factories and individual workshops. Selection and calculation of technological and water-sludge enrichment schemes, selection and calculation of main and auxiliary equipment. Organization of design of buildings and structures, general principles of equipment layout. Repair, storage and tail facilities, master plan. CAD elements in the design of processing plants.

KNOWLEDGE, SKILLS, SKILLS AT THE END OF THE COURSE
Undergraduates in the course of studying the discipline should - master modern design and layout solutions of advanced domestic and foreign factories; progressive directions in the design, reconstruction and expansion of existing enterprises; new design methods (CAD); methods of selection, justification and calculation of technological schemes (using computers), main and auxiliary technological equipment; - to learn, by making specific design decisions, to use theoretical knowledge and practical skills on the technology of enrichment of raw materials, as well as the necessary regulatory documents for the selection and justification of technological schemes of enrichment.

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