

**NJSC "Kazakh National Research Technical University named after K.I. Satpayev"**

**Institute of Metallurgy and Industrial Engineering  
Department of Metallurgy and Mineral Processing**

**EDUCATIONAL PROGRAM**

**"MINERAL PROCESSING"**

**PhD on the educational program «8D07201-Mineral Processing»**

on the basis of the following specialties of the invalidated Classifier of specialties:  
"6D073700-Mineral processing"

1st edition



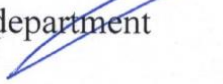
in accordance with the State Educational Standard of Higher Education 2018

**Almaty 2020**


Designed by:	Reviewed: meeting of the Board of the Institute	Approved by: UMC KazNRTU	Pages 1 of 27
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**The program was drawn up and signed by the parties:**

**From KazNRTU named after K. Satpayev:**

- 1. Head of the department "MaMP"  Barmenshinova M.B.
- 2. Director of the Institute of Metallurgy and Industrial engineering  Yelimesov K.K.
- 3. Chairman of the TG of the department "MaMP", professor  Shautenov M.R.

**From the employer:**

- 1. Chief concentrator LLP "KAZ Minerals"  Dzhetybayeva U.K.

Approved at a meeting of the Educational and Methodological Council of the Kazakh National Research Technical University named after K.I. Satpayev. Protocol No. 4 of 12.01.2020.

**Qualification:**

Level 8 of the National qualifications framework:  
 8D07 Engineering, manufacturing and construction industries  
 8D072 Manufacturing and processing industries

**Professional competence:** design and engineering, design and research activities, improvement and optimization of concentration production. Implementation of the development and implementation of technological processes for the processing of mineral, natural and technogenic raw materials. Assessment of innovative and technological risks when introducing new technologies. Competence in marketing high-tech technologies. Skills of setting tasks and problems, their systemic solution using innovative approaches, methods of constructing concepts and strategies of activity. Systemic and strategic thinking, skills of making mutually beneficial decisions using logical methods, building and playing models of professional activity and interaction in the mining and processing industry.

Designed by:	Reviewed: meeting of the Board of the Institute	Approved by: UMC KazNRTU	Pages 2 of 27
--------------	---	--------------------------	---------------

**Brief description of the program:**

**1 The objectives** of the educational program of the specialty of doctoral studies "Mineral enrichment" is the training of highly qualified specialists with basic competencies in the field of solving organizational and production problems in the implementation of innovative projects in the field of mineral and man-made raw materials enrichment; formation of personnel for an innovative economy for the processing of minerals, covering modern energy-saving technologies, project activities, innovative solutions, entrepreneurship in the high-tech sphere. The educational program is aimed at the implementation by graduates of the implementation of their developments in production and commercialization of the scientific results obtained.

**2 Types of work.** Specialists who have completed doctoral studies must have basic competencies in the field of solving organizational and production problems in the implementation of innovative projects, be prepared to develop plans and programs for organizing innovative activities at the enterprise along the entire chain of the innovation cycle "fundamental research - research and development (R&D) - production of new types products ", own modern methods and techniques of working with personnel, methods of creating innovative teams.

The specialist receives an education of a higher quality (level), which should provide him with additional opportunities in the field of professional activity in comparison with a bachelor's degree, including the right to independently conduct individual works (projects), make the necessary decisions, etc.

*Research activities: experimental research of processes, units and products; application of methods for planning experiments and statistical data processing; application of methods of mathematical modeling of processes; carrying out literary and patent searches, drawing up reports, reviews, conclusions, participating in the implementation of technological processes for obtaining conditioned concentrates; develops technological processes for obtaining enrichment products from feedstock; calculates the main and selects auxiliary equipment, develops and investigates mathematical models of enrichment processes.*

**3 Objects of professional activity.** The objects of professional activity of graduates are concentration factories, enterprises, chemical, mining, chemical and machine-building industries, industrial research and design institutes, factory laboratories, higher educational institutions, consulting companies, scientific, innovation centers and banks.

## PASSPORT OF THE EDUCATIONAL PROGRAM

### 1 Scope and content of the program

The educational program for the preparation of a Doctor of Philosophy (PhD) has a scientific and pedagogical focus and involves fundamental educational, methodological and research training and in-depth study of disciplines in the relevant areas of science for the system of higher and postgraduate education and the scientific sphere.

The educational program for the training of a doctor in the profile assumes fundamental educational, methodological and research training and in-depth study of disciplines in the relevant areas of science for the branches of the national economy, the social sphere: education, medicine, law, art, economics, business administration and in the field of national security and military affairs.

Educational programs for doctoral studies in terms of vocational training are developed on the basis of studying the experience of foreign universities and research centers that implement accredited training programs for PhD doctors or doctors in the field.

The content of the educational program of specialized doctoral studies is established by the university independently.

The main criterion for the completeness of the educational process for the preparation of doctors of philosophy (PhD) (doctor in the profile) is the mastering of at least 180 academic credits by a doctoral student, including all types of educational and scientific activities.

The term of study in doctoral studies is determined by the amount of acquired academic credits. Upon mastering the established amount of academic credits and achieving the expected learning outcomes for obtaining a PhD or profile, the doctoral educational program is considered fully mastered.

The training of personnel in doctoral studies is carried out on the basis of educational master's programs in two directions:

- 1) scientific and pedagogical with a training period of at least 2 years;
- 2) specialized with a training period of at least 1 year.

### EP content

The content of the doctoral study program consists of: 1) theoretical training, including the study of cycles of basic and major disciplines; 2) practical training of doctoral students: various types of practices, scientific or professional internships; 3) research work, including the implementation and defense of a doctoral dissertation PhD 4) final certification.

The educational program includes the following stages of doctoral students training: current trends in the development of the theory and technology of concentration production; theory and technology of selective disintegration of mineral

Designed by:	Reviewed: meeting of the Board of the Institute	Approved by: UMC KazNRTU	Pages 4 of 27
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raw materials; nanotechnology of mineral and non-traditional raw materials; conditioning of circulating and purification of waste waters of concentration production; methods for optimizing design solutions for mining and processing complexes; theory and technology of biohydrometallurgical processing of refractory raw materials. Ability to choose disciplines from the catalog of elective disciplines of Satbayev University.

### **Objectives of the educational program:**

The objectives of the educational program are:

- training of professionals in analytical, consulting and research activities;
- independent conduct of research and development, research and development, any project activities in the field of enrichment; compliance with international engineering qualifications;
- training of specialists for the implementation of pedagogical activities in universities by profile;
- retraining and advanced training of specialists and managers;
- the graduate must master the basic laws of economic development; factors affecting the technical and economic efficiency of production; knowledge of sociology and psychology in enterprise management; the ability to qualitatively and quantitatively substantiate management decisions.
- assessment of innovation and technological risks in the introduction of new technologies;
- competence in the implementation of the marketing of science-intensive technologies;
- the development of personal scientific-metric indicators of graduates;
- foreign internship.

### **2 Requirements for applicants**

Persons with a Master's degree and work experience of at least 1 (one) year are admitted to doctoral studies.

Enrollment in the number of doctoral students is carried out by the admissions committees of universities and scientific organizations based on the results of the entrance exam for the groups of doctoral studies and a certificate confirming proficiency in a foreign language in accordance with the common European competences (standards) of foreign language proficiency.

When enrolling in universities, doctoral students independently choose an educational program from the corresponding group of educational programs.

The enrollment of persons for the targeted training of doctors of philosophy (PhD) under the state educational order is carried out on a competitive basis.

The procedure for admitting citizens to doctoral studies is established in accordance with the "Standard rules for admission to training in educational organizations that implement educational programs of postgraduate education."

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

At the "entrance" the doctoral student must have all the prerequisites necessary for mastering the relevant professional doctoral curriculum. The list of required prerequisites is determined by the higher education institution independently.

In the absence of the necessary prerequisites, the doctoral student is allowed to master them on a paid basis. In this case, doctoral studies begin after the doctoral student has fully mastered the prerequisites.

### **3 Requirements for completing studies and obtaining a diploma**

Persons who have mastered the educational program of doctoral studies and defended their doctoral dissertation, with a positive decision of the dissertation councils of a university with a special status or the Committee for Control in the Field of Education and Science of the Ministry of Education and Science of the Republic of Kazakhstan, based on the results of the examination, are awarded the degree of Doctor of Philosophy (PhD) or Doctor of Science in profile and issued a state diploma with an attachment (transcript).

Persons who have received a PhD degree, to deepen scientific knowledge, solve scientific and applied problems on a specialized topic, carry out a postdoctoral program or conduct research under the guidance of a leading scientist chosen by the university.

#### 3.1 Requirements for key competencies of doctoral graduates:

##### 1) *have an idea:*

- about the main stages of development and the change of paradigms in the evolution of science;
- on the subject, ideological and methodological specifics of the natural (social, humanitarian, economic) sciences;
- about scientific schools of the relevant branch of knowledge, their theoretical and practical developments;
- on the scientific concepts of world and Kazakh science in the relevant field;
- on the mechanism of implementation of scientific developments in practice;
- about the norms of interaction in the scientific community;
- about the pedagogical and scientific ethics of the scientist-researcher;

##### 2) *know and understand:*

- modern trends, directions and patterns of development of domestic science in the context of globalization and internationalization;

- methodology of scientific knowledge;
- achievements of world and Kazakh science in the relevant field;
- (to understand and accept) the social responsibility of science and education;
- perfect foreign language for scientific communication and international cooperation;

3) *be able to:*

- organize, plan and implement the process of scientific research;
- analyze, evaluate and compare various theoretical concepts in the field of research and draw conclusions;
- analyze and process information from various sources;
- conduct independent scientific research, characterized by academic integrity, based on modern theories and methods of analysis;
- generate your own new scientific ideas, communicate your knowledge and ideas to the scientific community, expanding the boundaries of scientific knowledge;
- to choose and effectively use modern research methodology;
- to plan and predict their further professional development;

4) *have skills:*

- critical analysis, assessment and comparison of various scientific theories and ideas;
- analytical and experimental scientific activities;
- planning and forecasting research results;
- oratory and public speaking at international scientific forums, conferences and seminars;
- scientific writing and scientific communication;
- planning, coordinating and implementing research processes;
- a systematic understanding of the field of study and demonstrate the quality and effectiveness of the selected scientific methods;
- participation in scientific events, fundamental scientific domestic and international projects;
- leadership management and team leadership;
- responsible and creative attitude to scientific and scientific-pedagogical activities;
- conducting patent search and experience in transferring scientific information using modern information and innovative technologies;
- protection of intellectual property rights to scientific discoveries and developments;
- free communication in a foreign language;

5) *be competent:*

- in the field of scientific and scientific-pedagogical activity in conditions of rapid renewal and growth of information flows;
- in carrying out theoretical and experimental scientific research;
- in the formulation and solution of theoretical and applied problems in scientific research;
- in conducting a professional and comprehensive analysis of problems in the relevant area;
- in matters of interpersonal communication and human resource management;
- in matters of university training of specialists;
- in the examination of scientific projects and research;
- in ensuring constant professional growth.

3.2 Requirements for research and development work of a student under the PhD program:

- 1) compliance with the main problems of the educational program of doctoral studies, on which the doctoral dissertation is defended;
- 2) is relevant and contains scientific novelty and practical significance;
- 3) is based on modern theoretical, methodological and technological achievements of science and practice;
- 4) is based on modern methods of data processing and interpretation using computer technology;
- 5) carried out using modern scientific research methods;
- 6) contains research (methodological, practical) sections on the main protected provisions.

3.3 Requirements for the organization of practices:

The practice is carried out with the aim of developing practical skills in scientific, scientific, pedagogical and professional activities.

The educational program of doctoral studies includes:

- 1) teaching and research practice - for students of the Ph.D. program;
- 2) industrial practice - for students under the program of specialized doctoral studies.

During the period of teaching practice, doctoral students, if necessary, are involved in conducting classes in bachelor's and master's degrees.

The research practice of a doctoral student is carried out with the aim of studying the latest theoretical, methodological and technological achievements of domestic and foreign science, as well as consolidating practical skills, applying modern research methods, processing and interpreting experimental data in the dissertation research.

The industrial practice of a doctoral student is carried out in order to consolidate the theoretical knowledge gained in the learning process and improve the professional



level.

The content of research and industrial practice is determined by the topic of the doctoral dissertation.

## 4 Working curriculum of the educational program

### 4.1. Working curriculum doctoral PhD "Mineral processing"

Academic degree: Doctor of Philosophy (PhD)

Study period: 3 years

year of study	code	Name of disciplines	The cycle	Acad. credits	lec/lab/prac/ iws	Prerequisites	code	Name of disciplines	The cycle	Acad. credits	lec/lab/prac/ iws	Prerequisites
1	<b>1 semester</b>					<b>2 semester</b>						
	MET321	Research methods	BD IC	6	2/0/1/3		AAP345	Doctoral student research work, including internships and doctoral dissertations	DSRW	24		
	LNG304	Academic writing	BD IC	6	2/0/1/3		AAP350	Pedagogical practice	BD	10		
	MET316	Air conditioning of recycling and waste water treatment of processing plants	BD OC	6	2/0/1/3							
	MET317	Methods for optimizing design solutions for mining and processing complexes	PD OC	6	2/0/1/3							
	MET318	Theory and technologies of biohydrometallurgical processing of difficult-to-process raw materials	PD OC	6	2/0/1/3							
	<b>Total</b>			<b>30</b>			<b>Total</b>			<b>34</b>		
2	<b>3 semester</b>					<b>4 semester</b>						
	AAP345	Doctoral student research work, including internships and doctoral dissertations	DSRW	24			AAP346	Doctoral student research work, including internships and doctoral dissertations	DSRW	25		
	AAP349	Research scientific training	PD	10								
	<b>Total</b>			<b>34</b>			<b>Total</b>			<b>25</b>		
3	<b>5 semester</b>					<b>6 semester</b>						
	AAP346	Doctoral student research work, including internships and doctoral dissertations	DSRW	25			AAP346	Doctoral student research work, including internships and doctoral dissertations	DSRW	25		
							ECA303	Writing and defending doctoral dissertation	FA	12		
	<b>Total</b>			<b>25</b>			<b>Total</b>			<b>37</b>		
<b>In all</b>										<b>185</b>		

Number of credits for the whole period of study	
Cycles of discipline	Credits
The cycle of general education disciplines	0
A cycle of basic disciplines (BD IC, BD OS)	28
A cycle of principal subjects (PD IC, PD OS)	22
All on the theoretical classes:	<b>50</b>
DSRW	123
Writing and defending a doctoral dissertation	12
<b>In all:</b>	<b>185</b>

**MODULAR CURRICULUM**

Education program "**8D07201 - Mineral processing**"

Form of education: Full-time    Duration: 3 years

Academic degree: Doctor of philosophy PhD

The cycle	code	Name of disciplines	Semester	Acad. credits	lec.	lab.	prac	IWS	Type of control	Chair
<b>Profile training module</b>										
<b>Basic disciplines (BD) (28 credits)</b>										
<b>Required component (12 credits)</b>										
BD	MET321	Research methods	1	6	2	0	1	3	Exam	MPHE&TSM
BD	LNG304	Academic writing	1	6	2	0	1	3	Exam	EL
<b>Component of choice (6 credits)</b>										
BD	MET316	Air conditioning of recycling and waste water treatment of processing plants	1	6	2	0	1	3	Exam	M&MP
<b>Practice-oriented module</b>										
	AAP350	Pedagogical practice	2	10					Report	M&MP
<b>Profile studies (PS) (22 credits)</b>										
<b>Component of choice (12 credits)</b>										
PS	MET317	Methods for optimizing design solutions for mining and processing complexes	1	6	2	0	1	3	Exam	M&MP
PS	MET318	Theory and technologies of biohydrometallurgical processing of difficult-to-process raw materials	1	6	2	0	1	3	Exam	M&MP
<b>Practice-oriented module</b>										
	AAP349	Research scientific training	3	10					Report	M&MP
<b>Research Module</b>										
DSRW	AAP345	Doctoral student research work, including internships and doctoral dissertations	2	24						M&MP
DSRW	AAP345	Doctoral student research work, including internships and doctoral dissertations	3	24						M&MP
DSRW	AAP346	Doctoral student research work, including internships and doctoral dissertations	4	25						M&MP
DSRW	AAP346	Doctoral student research work, including internships and doctoral dissertations	5	25						M&MP
DSRW	AAP346	Doctoral student research work, including internships and doctoral dissertations	6	25						M&MP
<b>Final attestation module</b>										
FA	ECA303	Writing and defending doctoral dissertation	6	12						M&MP
<b>Total</b>					<b>185</b>					

Designed by:

Reviewed: meeting of the Board of the Institute

Approved by: UMC KazNRTU

Pages 11 of 27

## **5 Descriptors of the level and amount of knowledge, abilities, skills and competencies**

The third level descriptors within the Comprehensive Qualifications Framework of the European Higher Education Area (QF-EHEA) reflect learning outcomes that characterize the student's abilities:

1) demonstrate a systematic understanding of the field of study, mastering the skills and research methods used in the field of enrichment.

A graduate of the doctoral enrichment program has knowledge of building cooperative systems of activity and interaction, methodology for modeling and managing macrosocial and macroeconomic systems in the mining and metallurgical industry. Has knowledge of safety and labor protection rules.

2) demonstrate the ability to think, design, implement and adapt the essential research process with a scientific approach; Demonstrates systematic and strategic thinking, skills in making mutually beneficial decisions using logical methods, building and playing models of professional activity and interaction.

3) contribute with their own original research to expand the boundaries of the scientific field, which deserves publication at the national or international level;

4) critically analyze, evaluate and synthesize new and complex ideas. Independence: management activities involving the creation of a strategy for the functioning and development of large institutional structures of the industry on a national scale. Responsibility: for the planning, development and results of business processes that can lead to significant changes or development. Complexity: activities involving solving development problems, developing new approaches, using a variety of methods. Resource management to achieve strategic goals.

5) communicate their knowledge and achievements to colleagues, the scientific community and the general public;

6) to promote, in an academic and professional context, the technological, social or cultural development of a knowledge-based society.

## **6 ECTS Diploma Supplement**

The application was developed according to the standards of the European Commission, Council of Europe and UNESCO / CEPES. This document is for academic recognition only and is not an official proof of education. Not valid without a university degree. The purpose of completing the European Annex is to provide sufficient information about the holder of the diploma, the qualification obtained, the level of this qualification, the content of the study program, the results, the functional purpose of the qualification, as well as information about the national education system. The application model that will be used to translate grades uses the European Credit Transfer or Transfer System (ECTS).

Designed by:	Reviewed: meeting of the Board of the Institute	Approved by: UMC KazNRTU	Pages 12 of 27
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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 going abroad for professional recognition, additional legalization of the educational diploma is required. The European Diploma Supplement is completed in English upon individual request and is issued free of charge.

Doctor of Philosophy PhD in Mineral Processing, level 8 of the national qualifications framework with the right to hold the following positions: 6, 7 job level, 8 level: top managers of institutions, organizations and enterprises of the mining and metallurgical industry according to the Sectoral Qualifications Framework "Mining and Metallurgical Industry" dated July 30, 2019 No. 1 of the Association of Legal Entities "Republican Association of Mining and Mining and Metallurgical Enterprises".



## Methods of scientific research

CODE - MET321

CREDIT - 6 (2/0/1/3)

PREREQUISITE -

### PURPOSE AND OBJECTIVES OF THE COURSE

**Purpose of the course:** is to acquire knowledge about the laws, principles, concepts, terminology, content, specific features of the organization and management of scientific research using modern methods of scientometrics.

**Course objectives:**

- acquaintance with the basic theoretical provisions, laws, principles, terms, concepts, processes, methods, technologies, tools, operations for the implementation of scientific activities;
- study of methods of planning and organizing scientific research;
- acquaintance with the general methodology of scientific intent, creativity, the general scheme of organizing scientific research, the practice of using methods of scientific knowledge in the field of the relevant industry (mining and metallurgical complex);
- study of methods of planning and organizing scientific research;
- acquaintance with the general methodology of scientific design, creativity, the general scheme of organizing scientific research, the practice of using methods of scientific knowledge in the field of the relevant industry (mining and metallurgical complex);
- studying the mechanism of scientific research, analysis, conducting experiments, organizing surveys, drawing up questionnaires, etc .;
- mastering the skills of choosing a scientific research topic and selecting the necessary bibliographic publications and information materials on the research topic;
- practice of working with scientific databases (ORCID, SCOPUS, Google Scholar, Web of Science, Elsevier, ClarivateAnalytics, Science Direct, Wiley InterScience, Cambridge Journals Online, RSCI, ProQuest Dissertations & Theses, databases of metallurgical and Canadian societies TMS and Met Soc, patent databases Derwent Innovations Index, etc.), the study of scientometrics and scientometric indicators; practice of selecting a journal for publication (understanding the quartiles Q1, Q2, Q3, Q4 WoS, CiteScore percentiles in the Scopus database),
- study of the basic methods of scientific research;
- study of procedures for setting and solving scientific problems of information processes and informatization of enterprises and organizations;
- acquaintance with the possibilities of conducting scientific research in the international community in the field of fundamental and applied metallurgy;
- study of standards and norms for the registration of scientific research results, preparation of scientific projects, reports, publications for seminars and conferences;
- consideration of procedures for searching in global networks for information on scientific developments, opportunities for scientific contacts, applications for scientific grants of various levels;
- acquaintance with the procedures for approbation of the results of scientific research, preparation of publications based on the results of scientific research;
- study of methods of presentation of scientific materials and the formation of a manuscript of a scientific work, registration of a PhD thesis.

### SHORT DESCRIPTION OF THE COURSE

The subject of studying the discipline "Methods of scientific research" is the problem of presenting the methodology of scientific creativity to novice researchers, the organization of scientific work, the use of methods of scientific knowledge and the application of logical laws and rules in practice.

Designed by:	Reviewed: meeting of the Board of the Institute	Approved by: UMC KazNRTU	Pages 14 of 27
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The program of the course "Methods of Scientific Research" is aimed at intensive study of the problems faced by researchers in the process of solving various scientific problems characteristic of modern society.

**KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

- *professional*: knowledge: about critical thinking; on general scientific methods and their application in scientific research; some special methods and their application in scientific research; on methods of collecting and processing scientific data; on the role of technical sciences and engineering research in modern science; have an understanding of the methods of system and correlation analysis, modeling and optimization methods;

- *managerial*: to draw up plans for the analysis of literature data, the implementation of experimental work; formulate the goals, concepts and objectives of the proposed research; apply methods of ranking, abstraction and formalization in the analysis of literary and experimental scientific data; work with measuring instruments and obtained experimental data; perform SWOT analysis of scientific data and technological solutions; assess risks and ways to prevent them when planning scientific research; submitting applications for projects of any type; work with scientific bases and scientometric indicators.

- *communicative*: the ability to work in a team; show of initiative; consistency of judgments; the ability to effectively cooperate with other people, to build subject-subject relations in the process of professional activity, to develop a collective solution to specific technical and theoretical problems.

**Academic writing**

CODE - LNG304

Academic Credits - 6 (2/0/1/3)

PREREQUISITE - LNG203

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**PURPOSE OF THE COURSE**

Development of skills and competencies in the field of research and development of skills in writing qualification studies. The study of the discipline is based on the development and improvement of skills in the field of written scientific and methodological communication, which provides a high level of training for doctoral students necessary for effective communication in the scientific and academic environment.

**DISCIPLINE OBJECTIVES**

The objectives of the discipline are to familiarize doctoral students with the basic requirements for writing in a scientific language; - formation of skills in expressing reasoned ideas and opinions in writing, using professional vocabulary and terminology; - development of text editing skills; - teaching the techniques of correct and logical construction of the structure of scientific research; - preparation for writing articles, scientific papers and annotations; - the study of techniques for a free and reasoned presentation of thoughts on a scientific professional problem.

**BRIEF DESCRIPTION OF THE DISCIPLINE**

The course is designed to update and develop knowledge in the field of scientific research and writing qualification papers. The study of the course is aimed at the development and improvement of competencies in the field of written scientific communication, which provides a high level of training for doctoral students necessary for effective communication in the academic environment. The objectives of the discipline are to familiarize doctoral students with the basic requirements for writing in a scientific language; formation of skills in written scientific communication; the formation of skills to express ideas in writing and argue them; teaching methods of structuring academic work; preparation for writing articles, scientific papers and annotations; the formation of skills for a free and reasoned presentation of thoughts on a scientific problem, using the appropriate vocabulary in a professional language; development of text editing skills.

**KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

As a result of mastering the discipline, a doctoral student must:

***Know:***

- grammatical phenomena necessary for written presentation, translation and editing; - complex syntactic structures of scientific and business speech; - technology of structuring the academic text; - features of the scientific style of written texts; principles of organizing scientific texts; - vocabulary representing a neutral scientific style, the structure of business writing; - basic terms, concepts and categories of the language of the specialty; - various ways to hypothesize and build evidence.

***Be able to:***

- apply the knowledge gained in the preparation and writing of a research paper in a written format; - freely read the original literature of the relevant branch of knowledge in a foreign language; - work with bibliography; - to draw up information extracted from foreign sources in the form of translation, abstract, annotation; - to compare the content of different sources of information on the problem of scientific research, to critically assess the opinion of the authors; - correctly organize your own ideas, substantiate clearly and convincingly, and correctly express them in writing.

Designed by:	Reviewed: meeting of the Board of the Institute	Approved by: UMC KazNRTU	Pages 16 of 27
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**Own:**

- the language of the specialty (professional conceptual and terminological apparatus) in the amount of at least 4000-4500 units. Of these, 3000-3300 units are neutral and scientific vocabulary in a wide and narrow profile, 1200 units of vocabulary related to the chosen specialty for the development of oral speech; - basic techniques of reading original literature in the specialty of various styles and genres; - the style of written communication associated with the scientific work of a doctoral student; - culture of thinking, ability to generalize and analyze information; - the skills of analyzing a scientific text. Demonstrate the ability and readiness: - to extract and reproduce basic information in a foreign language in writing; - use reference materials in a foreign language; - to self-development, to improve their foreign language competence; - establish professional contacts with native speakers, exchange information in a foreign language; - to scientific work, using the language of the specialty

## Conditioning of circulating and treatment of waste waters of concentration production

CODE - MET316

CREDIT - 6 (2/0/1/3)

PREREQUISITE - MET280

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### PURPOSE AND OBJECTIVES OF THE COURSE

*Purpose of the course:* Formation of the doctoral student's competencies necessary to solve professional, research and scientific-pedagogical problems in the field of circulating air conditioning and wastewater treatment of concentration production.

#### *Course objectives:*

The main task of studying the discipline is associated with the formation of an integrated approach to the creation of technological schemes for the purification of waste water and conditioning of circulating water by the directional formation of flows, taking into account their integration into existing production cycles.

### SHORT DESCRIPTION OF THE COURSE

Wastewater treatment for use as recycling (conditioning) and for discharge into water bodies is carried out by mechanical, chemical, physicochemical and biochemical methods. The cleaning process should be accompanied by additional extraction of valuable components lost with wastewater. The development and implementation of closed water circulation schemes involves the involvement of domestic and technological waste into the circulating water. A decrease in the concentration of ions, metals and technical fatty acids in the circulating waters, causing a decrease in flotation indicators, is achieved by their precipitation during the operation of preliminary mixing of wastewater streams with pH control.

### KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE

Upon completion of the course, purchased:

- **knowledge** of the principles of operation and the main technological characteristics of the facilities used for the treatment, neutralization and processing of industrial wastewater; designs of various devices used in industry; methodology for the design of treatment facilities based on technical calculations of the main equipment and devices used for wastewater treatment;
- **the ability** to collect, organize and analyze information data for the design of structures, engineering systems and equipment for water disposal and wastewater treatment; predict the results of their actions in spatial and temporal coordinates; to develop technology and standard equipment for cleaning the proposed type of wastewater; to determine the main technical characteristics of the devices used in the processes of purification and neutralization of effluents.
- **skills** of generalization, analysis, systematization of information, goal setting and choice of ways to achieve.

Designed by:	Reviewed: meeting of the Board of the Institute	Approved by: UMC KazNRTU	Pages 18 of 27
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**Methods for optimizing design solutions for mining and processing complexes**

CODE - MET317

CREDIT - 6 (2/0/1/3)

PREREQUISITE - MET280

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**PURPOSE AND OBJECTIVES OF THE COURSE**

*Purpose of the course:* Formation of the doctoral student's competencies necessary to solve professional, research and scientific-pedagogical problems in the field of optimization of design solutions for mining and processing complexes.

*Course objectives:*

The main task of studying the discipline is associated with the formation of an integrated approach to optimizing solutions, that is, in achieving the specified characteristics of systems at the lowest cost or the best characteristics with limited resource costs.

**SHORT DESCRIPTION OF THE COURSE**

Classification of mathematical optimization methods. Basic procedures of the design process. Design stages - business plan, feasibility study, technical design, detailed design. Expertise of investment projects. Initial data for design. Design solutions for a mining and processing complex.

**KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

Upon completion of the course, purchased:

- **knowledge** of the basic formulations of optimization problems; basic methods for solving problems, including numerical-analytical methods, the use of partial derivatives of objective functions; the main approaches to reducing the labor intensity of optimization;
- **the ability** to justify the choice of optimization methods for models for making design decisions in specific situations; develop sets of criteria for the tasks of making design decisions; apply parametric optimization methods for making design decisions;
- **skills** of generalization, analysis, systematization of information, setting goals and choosing ways to achieve, mastering the methods of parametric optimization of design solutions

**Theory and technology of biohydrometallurgical processing of refractory raw materials**

CODE - MET318

CREDIT - 6 (2/0/1/3)

PREREQUISITE - MET280

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**PURPOSE AND OBJECTIVES OF THE COURSE**

*Purpose:* To study the basic principles of beneficiation and biohydrometallurgical processing of refractory raw materials. To develop and implement practical methods and technical solutions in the field of processing refractory raw materials on a new scientific basis.

*Course objectives:*

- scientific and technical analysis of the technology of biohydrometallurgical processing of refractory ores, technological schemes and production experience of enterprises;
- technical and economic assessment of the efficiency of biohydrometallurgical processing of refractory ores.

**SHORT DESCRIPTION OF THE COURSE**

The current state of hydrometallurgical processes and equipment, theoretical foundations and technologies for the use of microorganisms in the leaching of metals, schemes for processing concentrates, the use of microorganisms for wastewater treatment, the experience of domestic and foreign enterprises, trends in the development of biohydrometallurgy for the processing of metals from ores and in the production of materials with increased added value , including obtaining nano-sized materials. Economic and environmental aspects of the use of biohydrometallurgical processing of refractory raw materials.

**KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

Upon completion of the course, purchased:

- **knowledge** of the optimal enrichment technological schemes, including combined enrichment methods with obtaining several commercial concentrates; on the main directions of increasing the complexity of the extraction of noble metals, sulfur, iron and other impurity components; on the criteria for choosing methods for calculating and designing technological schemes for the beneficiation of mineral raw materials, taking into account the complexity of its use; on the optimal combination of enrichment processes to increase the complexity of the use of raw materials, technological, economic and environmental indicators of processing and enrichment of useful ones.
- **ability** to develop technology and standard equipment for biohydrometallurgical processing of refractory ores;
- **skills** of generalization, analysis, systematization of information, goal setting and choice of ways to achieve.

**Research work of a doctoral student, including an internship and the implementation of a doctoral dissertation**

CODE - AAP345

CREDIT – 24

PREREQUISITE -

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**PURPOSE AND OBJECTIVES OF THE COURSE**

The goal of doctoral studies is to prepare, taking into account the country's development prospects, competitive highly qualified personnel with high spiritual and moral qualities, capable of independent thinking and ensuring progressive scientific, technical, socio-economic and cultural development of society.

The main objectives of doctoral studies:

- meeting the needs of the individual in the field of vocational education, creating conditions for the implementation of the principle of individualization and differentiation of the learning process;
- deepening the theoretical and practical individual training of a doctoral student in the chosen direction of science and pedagogical activity;
- mastering by a doctoral student the most important and stable knowledge, providing a holistic perception of the scientific picture of the world;
- the formation of students' ability for self-improvement and self-development, needs and skills of independent creative mastery of new knowledge;
- training of specialists capable of solving modern scientific and practical problems and carrying out research, management and teaching activities in higher educational institutions.

**SHORT DESCRIPTION OF THE COURSE**

The research work of a doctoral student must:

- 1) correspond to the main problems of the specialty in which the doctoral dissertation is being defended;
- 2) be relevant, contain scientific novelty and practical significance;
- 3) be based on modern theoretical, methodological and technological achievements of science and practice;
- 4) be based on modern methods of data processing and interpretation using computer technology;
- 5) be carried out using modern scientific research methods;
- 6) contain research (methodological, practical) sections on the main protected provisions.

The results of research / experimental research work at the end of each period of their passage are formalized by the doctoral student in the form of a brief report.

The final result of the research / experimental research work of a doctoral student is a doctoral dissertation.

The topic of a doctoral dissertation is determined taking into account its relevance no later than two months after admission to doctoral studies. The direction of dissertation research, as a rule, should be associated with national priorities, either state programs, or programs of fundamental or applied research.

**KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

- **to have an idea:** about the main stages of development and the change of paradigms in the evolution of science; on the subject, ideological and methodological specifics of the natural (social, humanitarian, economic) sciences; about scientific schools of the relevant branch of knowledge, their theoretical and practical developments; on the scientific concepts of world and Kazakhstani science in the relevant field; on the mechanism for introducing scientific developments into practice; on the

Designed by:	Reviewed: meeting of the Board of the Institute	Approved by: UMC KazNRTU	Pages 21 of 27
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norms of interaction in the scientific community; about the pedagogical and scientific ethics of the scientist-researcher.

- **to know and understand:** modern trends, directions and patterns of development of domestic science in the context of globalization and internationalization; methodology of scientific knowledge; achievements of world and Kazakhstani science in the relevant field; (realize and accept) the social responsibility of science and education; perfect foreign language for scientific communication and international cooperation;

- **be able to:** organize, plan and implement the process of scientific research; analyze, evaluate and compare various theoretical concepts in the field of research and draw conclusions; analyze and process information from various sources; conduct independent scientific research characterized by academic integrity, based on modern theories and methods of analysis; generate your own new scientific ideas, communicate your knowledge and ideas to the scientific community, expanding the boundaries of scientific knowledge; choose and effectively use modern research methodology; plan and predict your further professional development;

- **have skills:** critical analysis, assessment and comparison of various scientific theories and ideas; analytical and experimental scientific activities; planning and forecasting research results; oratory and public speaking at international scientific forums, conferences and seminars; scientific writing and scientific communication; planning, coordinating and implementing research processes; a systematic understanding of the field of study and demonstrate the quality and effectiveness of the selected scientific methods; participation in scientific events, fundamental scientific domestic and international projects; leadership and team leadership; responsible and creative attitude to scientific and scientific-pedagogical activities; conducting patent search and experience in the transfer of scientific information using modern information and innovative technologies; protection of intellectual property rights to scientific discoveries and developments; free communication in a foreign language;

- **to be competent:** in the field of scientific and scientific-pedagogical activity in conditions of rapid renewal and growth of information flows; in carrying out theoretical and experimental scientific research; in the formulation and solution of theoretical and applied problems in scientific research; in conducting a professional and comprehensive analysis of problems in the relevant field; in matters of interpersonal communication and human resource management; in matters of university training of specialists; in the examination of scientific projects and research; in ensuring continuous professional growth.

**Teaching practice**

CODE - AAP350

CREDIT – 10

PREREQUISITE -

**PURPOSE AND OBJECTIVES OF THE COURSE**

The goals of passing pedagogical practice are:

- the formation of professional competencies among doctoral students, ensuring readiness for pedagogical activity in universities, designing the educational process in accordance with the profile of training and conducting certain types of training sessions using innovative educational technologies;
- development of practical skills and abilities of professional pedagogical and educational methodological work in higher educational institutions;
- consolidation of psychological and pedagogical knowledge in the field of professional pedagogy and the acquisition of skills of a creative approach to solving scientific and pedagogical problems.

The main tasks of teaching practice are:

- development of professional and pedagogical orientation of doctoral students;
- the development of doctoral students' skills in structuring and transforming scientific knowledge into educational material, oral and written presentation of subject material;
- familiarizing doctoral students with real problems solved in the educational process of an institution of higher professional education;
- study of modern educational technologies, methods, techniques, technologies of pedagogical activity in higher educational institutions;
- mastering the skills of diagnostics, control and evaluation of the effectiveness of educational activities;
- gaining experience in teaching at the university.

**SHORT DESCRIPTION OF THE COURSE**

Pedagogical practice in the system of postgraduate education is an important and integral component of doctoral educational programs and is a type of practical activity of students in the implementation of the educational and educational process in higher education, including teaching courses, organizing students' educational activities, scientific and methodological work, obtaining skills practical teaching activities.

Pedagogical practice is aimed at the formation of a comprehensive psychological, pedagogical and informational and methodological readiness of a doctoral student for scientific and pedagogical activities at the university.

Pedagogical practice is carried out during the period of theoretical training without interruption from the educational process in the amount established by the state compulsory standard of postgraduate education

**KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

At the end of the teaching practice, the doctoral student must:

- **know:** legal and regulatory framework for the functioning of the higher education system; the procedure for the implementation of the main provisions and documents governing the activities of the university to improve teaching, educational, methodological and scientific work at the university; modern approaches to modeling scientific and educational activities; the procedure for organizing the planning, maintenance and support of the educational process using the latest teaching technologies; basic principles, methods and forms of organizing the scientific and pedagogical process in an

Designed by:	Reviewed: meeting of the Board of the Institute	Approved by: UMC KazNRTU	Pages 23 of 27
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economic university; means and methods of enhancing the cognitive activity of students; basic requirements for the theoretical, practical and methodological readiness of the university teacher.

- **be able to:** use educational technologies, methods and techniques for conducting lectures and practical classes; to use, when presenting the subject material, the relationship of research and educational processes, including the possibility of attracting their own scientific research as a means of improving the educational process; carry out methodological work on the design and organization of the educational process; speak in front of an audience and create a creative atmosphere in the course of training sessions; analyze the difficulties arising in pedagogical activity and develop an action plan to solve them; choose adequate methods of planning and conducting training sessions; compose tasks, exercises, tests on various topics; structure and competently transform scientific knowledge into educational material.

- **possess:** skills of scientific-methodical and educational-methodical work in higher education; methodology and technology of conducting a training session (lectures, seminars, practical exercises, consultations on the discipline, course design, checking various types of homework); experience in the use of modern information technologies in educational and scientific processes; skills in public speaking, academic writing and scientific style of presentation of educational material; a method of self-assessment and self-analysis of the results and effectiveness of classroom activities of various types.

**Research practice**

CODE - AAP349

CREDIT – 10

PREREQUISITE -

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**PURPOSE AND OBJECTIVES OF THE COURSE**

*The purpose* of the research practice is: an analytical review of scientific and patent literature on the topic of scientific research in the field; acquisition of skills to work with modern scientific and / or technological equipment; acquiring the skills of independent research work, as well as work in 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 one's own scientific research, as well as leading specialists and scientists in the relevant field of research; be able to identify scientific priorities, as well as formulate urgent scientific tasks and problems; be able to substantiate and formulate the relevance, theoretical and practical significance of the selected topic of scientific research; develop and improve the ability to conduct independent research in accordance with the developed program; acquire skills in the presentation of the results of the research carried out in the form of a scientific report, article, report or separate sections of the dissertation.

**SHORT DESCRIPTION OF THE COURSE**

Research practice is a type of research activity aimed at deepening and systematizing the theoretical and methodological training of a doctoral student, his practical mastery of the technology of research activities, the acquisition and improvement of practical skills for performing scientific and experimental work in accordance with the requirements for the level of training of a PhD doctor.

The research practice of a doctoral student is carried out at the place of study or in scientific organizations, which can be considered as experimental platforms for conducting research related to the topic of the doctoral dissertation. During the practice, doctoral students are given the opportunity to conduct experimental research according to a pre-developed program that takes into account the objectives of the doctoral dissertation.

**KNOWLEDGE, ABILITY, SKILLS TO COMPLETE THE COURSE**

During the research practice, the doctoral student must:

*study:* sources on the topic being developed with the aim of using it when performing a doctoral dissertation; 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 registration of a master's thesis and scientific and technical documentation.

*perform:* scientific experiment in accordance with the plan of research work; 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 a doctoral dissertation; 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 doctoral dissertation on the basis of collected, generalized and scientifically processed information.

Designed by:	Reviewed: meeting of the Board of the Institute	Approved by: UMC KazNRTU	Pages 25 of 27
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**Writing and defending a doctoral dissertation**

CODE - ECA303

CREDIT – 12

PREREQUISITE -

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The purpose of the doctoral dissertation is to assess the scientific-theoretical and research-analytical level of the doctoral student, the formed professional and managerial competencies, the readiness to independently perform professional tasks and the compliance of its preparation with the requirements of the professional standard and the educational program of doctoral studies.

**SHORT DESCRIPTION**

Doctoral dissertation is a scientific work of a doctoral student, which is an independent study, in which theoretical provisions are developed, the totality of which can be qualified as a new scientific achievement, or a scientific problem is solved, or scientifically grounded technical, economic or technological solutions are set forth, the implementation of which makes a significant contribution to development the country's economy.

A doctoral dissertation is the result of the research / experimental research work of a doctoral student, carried out during the entire period of study of a doctoral student.

The defense of a doctoral dissertation is the final stage of the master's preparation. A master's thesis must meet the following requirements:

- The topic of the dissertation should be related to priority areas of development of science and / or government programs or programs of fundamental or applied research.
- The content of the dissertation, the goals and objectives, the scientific results obtained must strictly correspond to the topic of the dissertation.

The dissertation is carried out in compliance with the principles of independence, internal unity, scientific novelty, reliability and practical value.

## Content

1 Scope and content of the program	4
2 Requirements for applicants	5
3 Requirements for completing studies and obtaining a diploma	6
3.1 Requirements for key competencies of doctoral graduates	6
3.2 Requirements for R&D of a student under the Ph.D. program	8
3.3 Requirements for organizing practices	9
4 Working curriculum of the educational program	10
5 Descriptors of the level and amount of knowledge, skills, abilities and competencies	12
6 ECTS diploma supplement	12