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Mining and Metallurgical Institute named after O. A. Baikonurov**

Approved
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Model of a specialist

**8D07114 – Nanomaterials and Nanotechnologies
(Doctorate)**

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1 Brief description of the educational program 8D07114 - Nanomaterials and Nanotechnology

The purpose of the educational program "Nanomaterials and Nanotechnologies" is to train personnel for the system of higher, postgraduate education and the research sector, with in-depth scientific and pedagogical training.

Tasks of educational program:

- to deepen systemic knowledge among doctoral students, allowing them to give a critical assessment of the problems studied and discussed in the framework of modern production;
- to develop the skills of analyzing the designs of technological machines and equipment based on the use of modern digital technologies;
- deepen the ability to work with modern foreign and domestic scientific literature and give their own assessment of events in the creation of machines and equipment;
- to expand fluency in English, which is necessary for writing scientific articles, reading foreign scientific literature, continuing education in foreign educational institutions, participating in international conferences and in negotiations with foreign partners;
- develop the ability to contribute to the development of the latest trends in the digitalization of technological machines and equipment through original scientific research.

Types of labor activity

Graduates of this EP can conduct the following types of professional activities:

- pedagogical;
- research;
- organizational and managerial;
- production and technological.

Objects of professional activity

The objects of professional activity of the EP are:

- institutions of higher and postgraduate education;
- research organizations and technology parks;
- enterprises of machine-building and space orientation;
- enterprises for the production of nanomaterials.

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

Level 3 descriptors within the Comprehensive Framework for Qualifications of the European Higher Education Area (QF-EHEA) reflect learning outcomes that characterize the student's ability to:

- 1) demonstrate a systematic understanding of the field of study, mastering the skills and research methods used in the field of nanomaterials and nanotechnologies;
- 2) demonstrate the ability to think, design, implement and adapt a substantial research process with a scientific approach;
- 3) to contribute with their own original research to the expansion of 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;
- 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 society based on knowledge.

3. Requirements for applicants

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

Admission to the number of doctoral students is carried out by the admissions committees of universities and scientific organizations based on the results of an entrance examination for groups of doctoral educational programs and a certificate confirming knowledge of a foreign language in accordance with the pan-European competencies (standards) of foreign language proficiency.

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

Enrollment of persons for targeted training of Doctors of Philosophy (PhD) under the state educational order is carried out on a competitive basis.

The procedure for admission of citizens to doctoral studies is established in accordance with the "Model Rules for Admission to Education in Educational Organizations Implementing Educational Programs of Postgraduate Education".

The formation of a 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 free postgraduate education on a competitive basis in accordance with the state educational order, if they receive education at this level for the first time.

At the "entry", a 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.

4. Requirements for completing studies and obtaining a diploma

Persons who have mastered the educational program of doctoral studies and defended a doctoral dissertation, with a positive decision of the dissertation councils of a university with a special status or the Committee for Control in the Sphere 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 profile and a state diploma with an application (transcript) is issued.

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

4.1 Requirements for key competencies of PhD graduates:

1) have an idea:

- about the main stages of development and paradigm shift in the evolution of science;
- about 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;
- about the scientific concepts of world and Kazakhstani science in the relevant field;
- on the mechanism for introducing scientific developments into practice;
- on the norms of interaction in the scientific community;
- about the pedagogical and scientific ethics of a scientist-researcher;

2) know and understand:

- current 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;
- (recognize and accept) the social responsibility of science and education;
- a 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 study 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 their own new scientific ideas, communicate their knowledge and ideas to the scientific community, expanding the boundaries of scientific knowledge;
- choose and effectively use modern research methodology;
- plan and predict their further professional development;

3) have skills:

– critical analysis, evaluation and comparison of various scientific theories and ideas;

- analytical and experimental scientific activity;
- planning and forecasting the results of the study;
- oratory and public speaking at international scientific forums, conferences and seminars;

– scientific writing and scientific communication;

– planning, coordinating and implementing scientific 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 management;
- responsible and creative attitude to scientific and scientific-pedagogical activity;

– conducting a 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;

4) be competent:

- in the field of scientific and scientific-pedagogical activity in the conditions of rapid renewal and growth of information flows;

- in conducting theoretical and experimental scientific research;
- in setting and solving 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;

- to ensure continuous professional growth.

4.2 Requirements for R&D of a PhD student:

1) compliance with the main issues of the educational program of doctoral studies, on which the doctoral dissertation is defended;

2) 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 processing and interpreting data using

computer technology;

5) is performed using modern methods of scientific research;

6) contains research (methodological, practical) sections on the main protected provisions.

4.3 Requirements for the organization of practices:

The practice is carried out in order to form practical skills of scientific, scientific-pedagogical and professional activities.

The educational program of doctoral studies includes:

1) teaching and research practice - for students in the Ph.D. program;

2) industrial practice - for students under the profile doctoral program.

During the period of teaching practice, doctoral students, if necessary, are involved in conducting classes in undergraduate and graduate programs.

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 methods of scientific research, processing and interpreting experimental data in a 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 production practices is determined by the topic of the doctoral dissertation.

5 Requirements for the level of education of the graduate

5.1 Requirements for general education

The main requirement for general education is the graduate to receive a full-fledged and high-quality professional education, confirmed by the level of knowledge, skills, abilities and competencies, based on the criteria established by the state obligatory standard, their assessment both in content and in volume.

5.2 Requirements for social and ethical competence

A graduate must master the humanitarian culture, ethical and legal norms of relations to a person, society and the environment, a culture of thinking.

5.3 Requirements for economic and organizational and managerial competencies

The graduate must master the basic laws of economic development, factors affecting the technical and economic efficiency of production, knowledge of Industry 4.0 for enterprise management, the ability to qualitatively and quantitatively justify management decisions.

5.4 Requirements for professional competence

The graduate must have professional knowledge in his subject area, know the basics of scientific research and management principles, taking into account

technical, financial and human factors. The graduate must have a system of knowledge on the creation and application of modern technologies in their subject area, as well as in related areas; in accordance with the educational trajectory and field of activity chosen by him, must have sufficient knowledge, skills, abilities and competencies for the competent formulation and solution of design, operational, experimental research or design problems in his subject area.