Ministry of Higher Education and Science of the Republic of Kazakhstan
Kazakh National Research Technical University after K.I. Satpayev
Mining and Metallurgical Institute named after O. A. Baikonurov

APPROVED
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Model of a specialist

8D07103 – Materials science and engineering
(PhD degree)

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1 Brief description of the educational program 8D07103 - Materials science and engineering

The doctoral educational program 8D07103 – Materials Science and Engineering is aimed at training highly qualified scientific and academic personnel capable of conducting independent research, developing innovative materials and technologies, and solving complex scientific and engineering problems in modern materials science.

The program combines advanced theoretical training, independent research work, and practical experience in scientific laboratories and research centers. Graduates are prepared for careers in research institutions, universities, high-tech industries, and innovative engineering sectors in the Republic of Kazakhstan and internationally.

The purpose of the program is to prepare highly qualified researchers and scientific specialists in the field of materials science and engineering who possess advanced knowledge, research competencies, and the ability to generate new scientific knowledge and technological solutions.

Tasks of educational program:

- Development of advanced theoretical knowledge in materials science and engineering
- Training in modern experimental and analytical research methods
- Development of skills in independent scientific research and innovation activities
- Formation of competencies in scientific analysis, critical thinking, and problem solving
- Preparation of specialists capable of teaching and supervising research in higher education institutions
- Integration of doctoral students into international scientific and academic communities

Types of labor activity

Graduates of the doctoral program can perform the following professional activities:

- Scientific research activity in materials science and engineering
- Scientific and pedagogical activity in higher education institutions
- Innovation and technological activity related to the development of advanced materials
- Expert and analytical activity in research and industrial organizations
- Management of scientific and technological projects

Objects of professional activity

The objects of professional activity include:

- Metallic, ceramic, polymer, and composite materials
- Nanomaterials and functional materials
- Advanced structural and engineering materials
- Materials used in energy, electronics, aerospace, and mechanical engineering
- Technological processes of materials synthesis, processing, and modification
- Methods and equipment for materials characterization and diagnostics

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

Graduates of the doctoral program must demonstrate the highest level of professional competencies in accordance with doctoral qualification requirements.

Knowledge

Graduates must:

- Possess advanced theoretical knowledge in materials science and related engineering disciplines
- Understand modern scientific concepts, theories, and methodologies in materials research
- Know modern analytical, experimental, and computational methods for studying materials
- Understand international trends and scientific achievements in advanced materials and

nanotechnology.

Skills

Graduates must be able to:

- Conduct **independent scientific research** in the field of materials science
- Develop and apply modern experimental and theoretical research methods
- Analyze complex scientific data and interpret research results
- Publish research results in **international scientific journals**
- Present scientific results at **international conferences and seminars**
- Develop innovative technological solutions based on research findings

Competencies

Graduates must demonstrate the ability to:

- Generate **new scientific knowledge** and innovative ideas
- Manage scientific research projects and research teams
- Integrate interdisciplinary knowledge to solve complex scientific problems
- Apply advanced scientific methods in engineering and technological development
- Demonstrate leadership in research and academic environments
- Contribute to the development of science, technology, and innovation

3. Requirements for applicants

Admission to the doctoral program 8D07103 – Materials Science and Engineering at Satbayev University is carried out in accordance with national regulations of higher education in the Republic of Kazakhstan.

Applicants must meet the following requirements:

- Hold a **Master's degree or equivalent qualification** in materials science, physics, engineering, or related fields
- Successfully pass **entrance examinations or interviews** established by the university
- Demonstrate sufficient **research background and academic achievements**
- Provide a **research proposal or motivation letter** outlining the intended research direction
- Confirm proficiency in a **foreign language (usually English)** according to national requirements
- Submit all required admission documents (diplomas, transcripts, CV, identification documents).

4. Requirements for completing studies and obtaining a diploma

To obtain the PhD degree in Materials Science and Engineering, doctoral students must fulfill the following requirements:

Completion of Academic Coursework

- Successfully complete all **doctoral-level courses** included in the curriculum
- Acquire the required number of **ECTS credits**

Research Work

- Conduct **independent scientific research** under the supervision of a scientific advisor
- Demonstrate the ability to solve significant scientific problems in materials science

Scientific Publications

Doctoral students must publish research results in **scientific journals**, including publications indexed in international scientific databases.

Participation in Scientific Activities

Doctoral students must:

- Participate in **scientific conferences, seminars, and research projects**
- Present research results at academic and professional forums.

Doctoral Dissertation

The final stage of doctoral studies is:

- Preparation of an **original doctoral dissertation** containing significant scientific results
- **Public defense of the dissertation** before a specialized dissertation council.

After successful completion of all requirements, graduates are awarded the **Doctor of Philosophy (PhD) degree in Materials Science and Engineering** by Satbayev University.

4.1 Requirements for key competencies of graduates:

Graduates of the doctoral program must possess advanced competencies corresponding to the highest level of academic and professional qualification.

Have an idea of:

- Global scientific trends in **materials science, nanotechnology, and advanced functional materials**
- Modern research directions in materials engineering and interdisciplinary scientific fields
- The role of innovative materials in technological and industrial development
- International standards and ethical principles of scientific research.

Know and understand:

- Advanced theories and scientific concepts of **materials science and engineering**
- Modern experimental, analytical, and computational methods for studying materials
- Physical and chemical processes that determine the structure and properties of materials
- International scientific literature and current developments in the field.

Be able to:

- Conduct **independent scientific research** at an advanced level
- Formulate scientific problems and develop research methodologies
- Analyze complex experimental data and interpret scientific results
- Develop innovative solutions for materials design and technological applications
- Present scientific results in academic publications and international conferences.

Have skills in:

- Experimental research using modern scientific equipment and analytical techniques
- Scientific writing, preparation of research articles and project proposals
- Use of specialized scientific software and modeling tools
- Organization and management of scientific projects.

Be competent in:

- Generating new scientific knowledge and technological innovations
- Leading research groups and supervising young researchers
- Integrating interdisciplinary knowledge in solving complex engineering problems
- Conducting scientific and pedagogical activities in higher education institutions.

4.2 Requirements for R&D of a PhD student:

Research and development activities constitute the **core component** of doctoral education.

The R&D activities of doctoral students should include:

- Conducting **original scientific research** in the field of materials science and engineering
- Participation in **research projects funded by national or international organizations**
- Publication of research results in **peer-reviewed scientific journals**
- Presentation of research findings at **international scientific conferences and seminars**
- Participation in scientific discussions, workshops, and academic collaborations

Doctoral research must demonstrate:

- Scientific novelty
- Theoretical and practical significance
- Contribution to the development of materials science and engineering

The results of R&D activities form the basis of the **doctoral dissertation.**

4.3 Requirements for the organization of practices:

Practical training in doctoral programs is aimed at developing **research and pedagogical competencies.**

The doctoral program may include the following types of practice:

Research Practice

Research practice is carried out in university laboratories, research institutes, or industrial research centers. It aims to:

- Develop advanced research skills
- Master modern experimental and analytical methods
- Apply theoretical knowledge to scientific research problems.

Pedagogical Practice

Pedagogical practice is conducted in higher education institutions and includes:

- Participation in teaching undergraduate or graduate courses
- Preparation and delivery of lectures and practical classes
- Development of educational and methodological materials.

The organization of practices is coordinated by the relevant departments of Satbayev University in cooperation with research organizations and industrial partners.

5 Requirements for the level of education of the graduate

Graduates of the doctoral program must demonstrate the highest level of academic preparation and professional competence consistent with international doctoral standards and the higher education system of the Republic of Kazakhstan.

5.1 Requirements for general education

Graduates must:

- Possess advanced knowledge of **natural sciences and engineering disciplines**
- Demonstrate strong analytical and critical thinking abilities
- Be able to analyze complex scientific problems using interdisciplinary approaches
- Communicate effectively in **scientific and professional environments**
- Demonstrate the ability for **independent learning and continuous professional development.**

5.2 Requirements for social and ethical competence

Graduates must:

- Follow the principles of **academic integrity and scientific ethics**
- Understand the social responsibility of scientific research
- Respect cultural diversity and international collaboration
- Ensure environmental safety and sustainability in scientific and technological activities
- Demonstrate leadership and responsible behavior in research teams

5.3 Requirements for economic and organizational and managerial competencies

Graduates should be able to:

- Manage **scientific and innovation projects**
- Evaluate the economic feasibility of technological developments
- Participate in strategic planning and management of research activities
- Organize teamwork and coordinate research groups
- Understand the principles of **technology transfer and commercialization of scientific results**

5.4 Requirements for professional competence

Graduates must demonstrate the ability to:

- Conduct **independent fundamental and applied research** in materials science
- Develop new materials and technologies with improved functional properties
- Apply modern experimental, analytical, and computational methods in materials research
- Publish scientific results in **international peer-reviewed journals**
- Contribute to the development of **scientific knowledge and innovative technologies**
- Perform scientific and pedagogical activities in universities and research institutions.