Mining and Metallurgical Institute named after O.A. Baikonurov

Department of "Materials Science, Nanotechnology and Engineering Physics"

EDUCATIONAL PROGRAM
8D07103 Materials Science and Engineering

Code and classification of the field of education:
8D07"Engineering, manufacturing and construction industries"
Code and classification of training directions: **8D071 "Engineering and Engineering Trades"**
Group of educational programs: **D101 Material science and technology of new materials**

Level based on NQF: 8
Level based on IQF: **8**
Study period: 3 years
Amount of credits: **180**

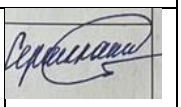
Almaty 2023

The educational program 8D07103 Materials Science and Engineeringwas approved at a meeting of the Academic Council of KazNTU named after K.I.Satpayev.

Protocol No. 2, «21» 10. 2022

was reviewed and recommended for approval at the meeting of K.I. SatbayevKazNRTU Educational and Methodological Council.

Protocol No. 3, «27» 10. 2022.

Full name	Academic degree/ academic title	Position	Workplace	Signature
Chairperson of Academic Committee:				
Serikkanov A.S.	Candidate of Physical and Mathematical Sciences	Director of "Physico-Technical Institute" LLP	"Physico-Technical Institute" LLP	
Teaching staff:				
Kudaibergenov K.K.	PhD	Head of Department	Non-profit Joint Stock Company "Kazakh National Research Technical University named after K.I. Satpayev"	
Smagulov D.U.	Doctor of Technical Sciences	Professor	Non-profit Joint Stock Company "Kazakh National Research Technical University named after K.I. Satpayev"	
Employers:				
Ismailov M.B.	Doctor of Technical Sciences	Director of the Department of Jet Propulsion and Materials Science.	National Center for Space Research and Technology JSC	
Murzalinov D.O.	PhD	Head of Laboratory	Physico-Technical Institute LLP	

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List of abbreviations and designations

Abbreviation		Full name
Ts	–	Teaching staff
EP	–	Educational program
OR	–	Registrar's Office
WC	–	Working Curriculum EP

1. Description of educational program

The main objectives of the educational program are:

- to provide scientific training of undergraduates for their successful solution of scientific and engineering problems of an interdisciplinary nature;

- develop the skills of scientific analysis, staging and conducting scientific research, including as a team member;

- develop skills in the possession and application of scientific research methods, technologies for obtaining and processing materials for a specific purpose;

- to develop ideas about professional and ethical responsibility, the ability to independently study and improve their qualifications during their lifetime for a successful career in scientific, scientific and industrial organizations and educational institutions engaged in solving scientific and technical problems.

The program is aimed at the following types of professional activity:

experimental research;

design and analytical;

production and technological;

scientific and pedagogical.

The objects of professional activity of the Master of Technical Sciences are:

employees of national companies, research centers, business structures, public administration of industry and committees on science and technology; teachers in higher educational institutions.

2. Purpose and objectives of educational program

Purpose of EP: The main purpose of the educational program is to provide scientific training for undergraduates to successfully solve scientific and engineering problems of an interdisciplinary nature, to develop the skills of scientific analysis, formulation and conduct of scientific research, to teach the skills of possession and application of scientific research methods, technologies for obtaining and processing materials for a specific purpose.

Tasks of EP:

The objectives of the educational program are consistent with the types of future professional activity and are as follows:

in the field of experimental research activities:

- analysis of the task of research in a given field based on the selection and study of literary and patent sources;
- diagnostics of the state and dynamics of objects of activity (materials, technological processes, equipment in various industries using the necessary tools and methods of analysis);
- study of the structure and properties of technical materials, their improvement and creation of new materials and technological processes for their manufacture;
- construction of mathematical models, computer modeling to solve the problem;
- carrying out measurements and research in the development of new materials and technologies according to a given methodology with the choice of modern technical means and computer processing of the results;
- in the field of design and analytical activities:
- formulation of the objective and objectives of the project (program) with the given criteria, target functions, constraints, building the structure of their relationships, identifying priorities for solving problems;
- development of generalized solutions to problems, analysis of these options, forecasting of consequences, finding compromise solutions in conditions of multi-criteria, uncertainty, planning and implementation of projects;
- development of production equipment projects taking into account mechanical, technological, design, operational, ergonomic, aesthetic and economic parameters;
- the use of information technology to select the necessary materials and equipment in the manufacture of finished products;
- in the field of production and technological activities:
- conducting physical and experimental studies using modern methods of measuring and processing the results obtained;
- introduction of technological processes of production, quality control of elements and assemblies for various purposes;

calculation of production rates, technological standards for material consumption, selection of standard equipment, preliminary assessment of the economic efficiency of the selected materials;

- efficient use of materials and equipment, selection and calculation of

technological process parameters for the preparation of finished products;

 quality control of materials and technologies;

- in the field of scientific and pedagogical activity:

ensuring high-quality transfer of skills and knowledge and the ability to work with staff during their training.

3. Requirements for evaluating the educational program learning outcomes

Learning outcomes include knowledge, skills and competencies and are defined both for the educational program as a whole and for its individual modules, disciplines or tasks.

The main task at this stage is to select assessment methods and tools for all types of control, with the help of which it is possible to most effectively assess the achievement of planned learning outcomes at the discipline level.

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.

4. Passport of educational program

4.1. General information

№	Field name	Comments
1	Code and classification of the field of education	8D07 "Engineering, manufacturing and construction industries"
2	Code and classification of training directions	8D071 "Engineering and engineering trades"
3	Educational program group	8D071 "Material Science and Technology"
4	Educational program name	8D07103 Materials Science and Engineering
5	Short description of educational program	The main objectives of the educational program are to provide scientific training of undergraduates for their successful solution of scientific and engineering problems of an interdisciplinary nature
6	Purpose of EP	The purpose of the educational program is to provide fundamental and practical training for students to solve scientific and engineering problems in various fields of technical physics and materials science, as well as to develop students' skills in engineering analysis and design.
7	Type of EP	New
8	The level based on NQF	8
9	The level based on IQF	8
10	Distinctive features of EP	Three - degree EP
11	List of competencies of educational program	KK1. Communicativeness KK2. Basic literacy in Natural science disciplines KK3. General engineering competences KK4.Professional competencies KK5. Engineering-computer competencies KK6.Engineering-working competencies KK7. Socio-economic competences KK8. Special-professional competences
12	Learning outcomes of educational program	LO1 to substantiate the choice of experimental methods for studying systems with micro- and nano-sizes;

		LO2 plan the organization and conduct of an experiment to obtain materials with special physical and chemical properties (porous nanostructures, magnetic nanomaterials, nanobiomaterials); LO 3 Integrate knowledge in professional activities and have the competence to argue their ideas when making decisions in the field of engineering and technology; LO 4 explain the specifics of the functional purpose of equipment in the field of materials science and the possibility of its digitalization; LO 5 apply physical and chemical methods for obtaining nano-objects and their composites for solving applied problems, as well as methods for describing structures, structures, composition, morphologies; LO 6 to study the current trends in advanced materials science for further scientific and pedagogical activities; LO 7 choose the best methods for solving the problems of materials science, nanoproduction, processing and modification of materials; LO 8 to model and evaluate the forecast of product quality by the parameters of the technological process in order to optimize it in accordance with the type of product obtained;; LO 9 investigate the structure of the material by conducting a physical experiment using laboratory equipment and modern scientific equipment;
13	Education form	Full - time
14	Period of training	3
15	Amount of credits	180
16	Languages of instruction	Kazakh, Russian
17	Academic degree awarded	PhD
18	Developer(s) and authors	Serikkanov A.S. Kudaibergenov K.K. Smagulov D.U. Ismailov M. B. Murzalinov D.O.

4.2. Relationship between the achievability of the formed learning outcomes based on educational program and academic disciplines

№	Discipline name	Short description of discipline	Amount of credits	Generated learning outcomes (codes)							
				PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8
Cycle of general education disciplines University component											
1	Academic writing	The course is aimed at developing academic writing skills and writing strategies for doctoral students in the field of engineering and natural sciences. The course focuses on the basics and general principles of academic writing for; writing effective sentences and paragraphs; using tenses in scientific literature, as well as styles and punctuation; writing abstracts, introductions, conclusions, discussions, conclusions, literature and resources used; quoting in the text; preventing plagiarism, and making presentations at a conference.	5		v				v		
2	Research methods	The course contributes to the formation of knowledge about the methods, methodology of scientific research, methods of collecting and processing scientific data, the principles of the organization of scientific research, the role of technical sciences, computer science and engineering research in modern science. The structure of technical sciences, the application of general scientific, philosophical, special methods of scientific research in theory and in practice are considered.	5		v					v	
Cycle of basic disciplines Component of choice											

3	Advanced structural technology hardening	The course content includes modern methods of materials research; classification of structural levels of solids, dimensional and morphological characteristics of granular, cellular and modulated and atomic and molecular structures. The features of real structures, stochasticity and the probability of evolution of complex systems are considered, the irreversibility, non-equilibrium, nonlinearity and unpredictability of processes in open systems, the autowave nature of material objects and processes, fractality and self-organization of structures of different levels under external influences are studied.	5	**v**			**v**				
4	Physics and technique of saving and renewable energy	Discipline is devoted to the description and analysis of renewable energy sources, their use in the overall energy balance of the country and regions. Discipline also covers the issues of world energy conservation in industry, agriculture and housing and communal facilities. The use of secondary energy resources and the improvement of environmental conditions are also being considered; technical and economic indicators of the use of renewable energy in agriculture; application of resource-saving technologies using renewable energy.	5	**v**					**v**		
5	Computer simulation of engineering tasks	The discipline studies the construction of a mathematical model that describes the process under study and numerical methods of calculation. The creation of a program that implements a computational algorithm that calculates and processes the information received is considered. The analysis of the results of calculations is also studied in comparison with a full-scale experiment.	5		**v**					**v**	
6	Semiconductor heterostructures and devices based on them	The discipline studies a multilayer structure of semiconductors with different bandgap widths of	5				**v**				**v**

		several microns. Materials are considered that have the same crystal structure, where charge carriers move freely through the layer boundaries. Such a concept as a heterojunction and related devices based on this phenomenon are being studied.									
7	Software for structuring materials	The course covers the basic concepts of structuring materials using software, as well as the use of analytical equipment and instruments. The discipline is a complex for the study of modern research methods and the use of materials. An overview of the current state of the software for the structure formation of materials is given. The course examines the processes in the field of theory and practice using modern software.	5					**v**			
8	Physicochemical methods of materials research	When studying the discipline, doctoral students will study the following aspects: the principles of studying the chemical composition and structure of matter through the use of physical methods of analysis, including atomic spectroscopy, optical spectroscopy, magnetic resonance spectroscopy, mass spectroscopy, IR spectroscopy.	5							**v**	

5. Curriculum of educational program

KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I.SATBAYEV

SATBAYEV UNIVERSITY

APPROVED
Chairman of the Management Board-
Rector of Kazntu named after K.Satpayev
M.K. Ikegenaev
«___» _____ 2022 y.

CURRICULUM
of Educational Program on enrollment for 2023-2024 academic year

Educational program 8D07103 - "Materials Science and Engineering"
Group of educational programs D101 - "Materials science and technology of new materials"

Form of study: full-time | **Duration of study: 3 year** | **Academic degree: Philosophy Doctor (PhD)**

Discipline code	Name of disciplines	Cycle	Total amount in credits	Total hours	Classroom amount lec/lab/pr	SIS (including TSIS) in hours	Form of control	Allocation of face-to-face training based on courses and semesters					
								1 course		2 course			
								1 semester	2 semester	3 semester	4 semester	5 semester	6 semester
CYCLE OF BASIC DISCIPLINES (BD)													
M-1. Module of basic training (university component)													
MET322	Scientific research methods	BD UC	5	150	2/0/1	105	E	5					
LNG305	Academic writing	BD UC	5	150	0/0/3	105	E	5					
component of choice													
PHY316	Advanced structural technology hardening	BD CCH	5	150	2/0/1	105	E	5					
PHY306	Physics and technique of saving and renewable energy				1/1/1,								
CYCLE OF PROFILE DISCIPLINES (PD)													
M-2. Module of professional activity (component of choice)													
PHY317	Applied tasks in material science	PD CCH	5	150	2/0/1	105	E	5					
PHY303	Physics of low-dimensional structures and systems				2/0/1								
PHY318	Software for structuring materials	PD CCH	5	150	2/0/1	105	E	5					
PHY302	Physicochemical methods of materials research				2/0/1								
M-3. Practice-oriented module													
AAP350	Pedagogical practice	BD UC	10						10				
AAP355	Research practice	PD UC	10							10			
M-4. Experimental research module													
AAP336	Research work of a doctoral candidate, including internships and completion of a doctoral dissertation	RWDS UC	5					5					
AAP347	Research work of a doctoral candidate, including internships and completion of a doctoral dissertation	RWDS UC	40						20	20			
AAP356	Research work of a doctoral candidate, including internships and completion of a doctoral dissertation	RWDS UC	60								30	30	
AAP348	Research work of a doctoral candidate, including internships and completion of a doctoral dissertation	RWDS UC	18										18
M-5. Module of final attestation													
ECA303	Writing and defending a doctoral dissertation	FA	12										12
Total based on UNIVERSITY:								30	30	30	30	30	30
								60		**60**		**60**	

Number of credits for the entire period of study

Cycle code	Cycles of disciplines	Credits			
			university component (UC)	component of choice (CCH)	Total
BD	Cycle of basic disciplines		20	5	25
PD	Cycle of profile disciplines		10	10	20
	Total for theoretical training:	*0*	*30*	*15*	*45*
	RWDS				*123*
FA	Final attestation	12			12
	TOTAL:	12	30	15	180

Decision of the Academic Council of Kaznu named after K.Satpayev. Protocol № 5 "24" 11 2022 y.

Decision of the Educational and Methodological Council of Kaznu named after K.Satpayev. Protocol № 3 "17" 11 2022 y.

Decision of the Academic Council of the Institute M&M. Protocol № 2 "17" 10 2022 y.

Vice-Rector for Academic Affairs — **Zhautikov B.A.**

Director of M&M Institute — **Rysbekov K.B.**

Head of the MN&EP Department — **Kudaibegenov K.K.**

Specialty Council representative from employers — **Serikkanov A.S.**