Mining and Metallurgical Institute named after O.A. Baikonurov

Department of "Materials Science, Nanotechnology and Engineering Physics"

EDUCATIONAL PROGRAM
8D07114 Nanomaterials and Nanotechnology

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:
D108 Nanomaterials and nanotechnologies

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

Almaty 2025

NON-PROFIT JOINT STOCK COMPANY "K.I. SATPAYEV KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY"

Educational program 8D07114 - "Nanomaterials and Nanotechnology" was approved at the meeting of K.I. Satbayev KazNRTU Academic Council
Minutes # 10 dated «06» 03 2025.
was reviewed and recommended for approval at the meeting of K.I. Satbayev KazNRTU Educational and Methodological Council
Minutes # 3 dated «20» 12 2025 .
Educational program 8D07114 - "Nanomaterials and Nanotechnology" was developed by Academic committee based on direction «8D071 Engineering and Engineering Trades»

Full name	Academic degree/ academic title	Position	Workplace	Signature
Chairperson of Academic Committee:				
Kakimov U.K.	PhD	Head of Department	Non-profit Joint Stock Company "Kazakh National Research Technical University named after K.I. Satpayev"	
Teaching staff:				
Azat S.	PhD	Professor	Non-profit Joint Stock Company "Kazakh National Research Technical University named after K.I. Satpayev"	
Kudaibergenov K.	PhD	Associate Professor	Non-profit Joint Stock Company "Kazakh National Research Technical University named after K.I. Satpayev"	
Kemelbekova A.	PhD in material science	Senior Lecturer	Non-profit Joint Stock Company "Kazakh National Research Technical University named after K.I. Satpayev»	
Yetish T.	Master of technical science, PhD student	Lecturer	Non-profit Joint Stock Company "Kazakh National Research Technical University named after K.I.	

			Satpayev»	
Employers:				
Mutushev A.	PhD	General Director	Scientific Production and Technical Center "ZHALYN"	
Students				
Lihanov S.		2rd year student	Non-profit Joint Stock Company "Kazakh National Research Technical University named after K.I. Satpayev»	
Altynov Y.		2nd year student	Non-profit Joint Stock Company "Kazakh National Research Technical University named after K.I. Satpayev»	
Serikkyzy A.		2nd year student	Non-profit Joint Stock Company "Kazakh National Research Technical University named after K.I. Satpayev»	

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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 educational program 8D07114 "Nanomaterials and nanotechnology" is the third level of qualification of the three-level higher education system.

The program is aimed at training specialists in a wide range of activities. The necessary basic knowledge and skills in the field of training highly qualified scientific and scientific-pedagogical personnel capable of: conducting fundamental, applied and innovative research in the field of obtaining nanomaterials and nanotechnology; developing new directions of nanomaterials and nanotechnology in the field of physics, chemistry, biology and medicine; commercializing the results of research and nanotechnology, experimental design work.

Graduates, having received the degree of "Doctor of PhD in the educational program 8D07114 "Nanomaterials and nanotechnology", have the following opportunities:

1. To develop methods for obtaining nanostructured and semiconductor materials based on plasma technologies and chemical synthesis;
2. To conduct experimental studies using X-ray diffraction analysis, optical microscopy and electrical research methods to obtain a description of the characteristics of nanomaterials;
3. Conducts theoretical assessments of the characteristics of nanomaterials using computer and numerical modeling methods;
4. To lead design and engineering works aimed at creating new electronic devices, circuits and devices for various functional purposes based on nanomaterials;
5. Commercialization of research and development results through participation in competitions;
6. Improves the properties of nanocomposite materials and medicines using modern plasma technologies and nanotechnology, including bionanotechnology;
7. Organizes research activities in the field of nanomaterials, bio- and nanotechnology, using new methods of analysis and production technologies, taking into account economic and environmental efficiency;
8. Development of scientific and methodological manuals based on the results of scientific research in the field of bio/nanotechnology and nanomaterials for their implementation in the educational process;
9. Analyzes and evaluates the results of innovative activities, modern theories, problems and approaches, new trends in the development of innovative nanomaterials;
10. To maintain and diagnose scientific and technical equipment in the field of bio/nanotechnology and nanomaterials, to make recommendations on improving the parameters and characteristics of the measuring system;

2. Purpose and objectives of educational program

The purpose of the EP:

The program is aimed at training scientific and scientific-pedagogical personnel capable of: conducting fundamental, applied and innovative research in the field of nanostructure synthesis; developing new directions of nanomaterials and nanotechnology in the field of physics, chemistry, biology and medicine; commercializing the results of research and development activities.

Tasks of the EP:

1) knowledge and understanding of the scientific and mathematical principles underlying various specializations in engineering physics and materials science;

2) the ability to apply the acquired knowledge to the formulation, formulation and solution of applied scientific problems in technical physics using recognized methods;

3) the ability to apply the acquired knowledge to the analysis of technical systems, processes and methods related to various specializations in engineering physics and materials science, including using modeling methods;

4) understanding of engineering systems design methodologies and the ability to apply them;

5) the ability to find the necessary literature, use databases and other sources of information;

6) the ability to analyze, plan and conduct the necessary research, interpret the data obtained and draw conclusions;

7) The ability to select and use appropriate equipment, tools and techniques;

8) Work effectively both individually and as a team member;

9) show awareness in the field of project management and business, knowledge and understanding of the impact of risks and changing conditions;

10) be aware of the need and have the ability to independently study and improve their skills throughout their lives;

11) understanding of health, safety, legal aspects and responsibility for engineering activities, understanding the impact of engineering solutions on the social context and the environment:

12) follow the code of professional ethics and standards of engineering practice.

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 assignments.

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.

4. Passport of educational program

4.1. General information

№	Field name	Comments
1	Code and classification of the field of education	8D07 "Engineering, processing and construction industries"
2	Code and classification of training directions	"8D071 " Engineering and Engineering"
3	Educational program group	D108 "Nanomaterials and nanotechnology"
4	Educational program name	8D07114 "Nanomaterials and Nanotechnology"
5	Short description of educational program	Educational program 8D07114 "Nanomaterials and Nanotechnology" is the last qualification level of the three-level higher education system
6	Purpose of EP	The program is aimed at training scientific and scientific-pedagogical personnel capable of: conducting fundamental, applied and innovative research in the field of nanostructure synthesis; developing new directions of nanomaterials and nanotechnology in the field of physics, chemistry, biology and medicine; commercializing the results of research and development activities.
7	Type of EP	New EP
8	The level based on NQF	8
9	The level based on IQF	8
10	Distinctive features of EP	No
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	Mutushev Alibek Zhumabekovich Kakimov Ulan Kadyrkhanuly Azat Seythan Kudaibergenov Kenes Kakimovich Kemelbekova Ainagul Erzhanovna Yetish Talshyn Erbolkyzy

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

NON-PROFIT JOINT STOCK COMPANY
"KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY NAMED AFTER K.I. SATBAYEV"

SATBAYEV UNIVERSITY

«APPROVED»
Decision of the Academic Council
NPJSC«KazNRTU
named after K.Satbayev»
dated 06.03.2025 Minutes № 10

WORKING CURRICULUM

Academic year	**2025-2026 (Autumn, Spring)**
Group of educational programs	**D108 - "Nanomaterials and nanotechnologies"**
Educational program	**8D07114 - "Nanomaterials and Nanotechnology"**
The awarded academic degree	**Doctor of Philosophy PhD**
Form and duration of study	**full time (scientific and pedagogical track) - 3 years**

Discipline code	Name of disciplines	Block	Cycle	Total ECTS credits	Total hours	lek/lab/pr Contact hours	in hours SIS (including TSIS)	Form of control	Allocation of face-to-face training based on courses and semesters						Prerequisites
									1 course		2 course		3 course		
									1 sem	2 sem	3 sem	4 sem	5 sem	6 sem	
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)															
CYCLE OF BASIC DISCIPLINES (BD)															
M-1. Module of basic training															
LNG305	Academic writing		BD, UC	5	150	0/0/45	105	E	5						
MET322	Methods of scientific research		BD, UC	5	150	30/0/15	105	E	5						
PHY322	Methods for synthesis and characterization of various nanostructures	1	BD, CCH	5	150	30/0/15	105	E	5						
PHY323	Theory and Application of Nanoscale Materials	1	BD, CCH	5	150	30/0/15	105	E	5						
M-4. Experimental research module															
AAP350	Pedagogical practice		BD, UC	10				R		10					
CYCLE OF PROFILE DISCIPLINES (PD)															
M-2. Module of professional activity															
PHY324	Advanced Characterization Techniques for nanomaterials	1	PD, CCH	5	150	30/0/15	105	E	5						
PHY325	Physico-chemical properties of nanomaterials	1	PD, CCH	5	150	30/0/15	105	E	5						
PHY326	Nanotechnologies for Energy and the Environment	2	PD, CCH	5	150	30/0/15	105	E	5						
PHY327	Functional nanomaterials	2	PD, CCH	5	150	30/0/15	105	E	5						
M-3. Practice-oriented module															
AAP355	Research practice		PD, UC	10				R			10				
M-4. Experimental research module															
AAP336	Research work of the doctoral student, including internships and doctoral dissertation		RWDS	5				R	5						
AAP347	Research work of the doctoral student, including internships and doctoral dissertation		RWDS	20				R		20					
AAP347	Research work of the doctoral student, including internships and doctoral dissertation		RWDS	20				R			20				
AAP356	Research work of the doctoral student, including internships and doctoral dissertation		RWDS	30				R				30			
AAP356	Research work of the doctoral student, including internships and doctoral dissertation		RWDS	30				R					30		
AAP348	Research work of the doctoral student, including internships and doctoral dissertation		RWDS	18				R						18	
M-5. Module of final attestation															
ECA325	Final examination (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			
		Required component (RC)	University component (UC)	Component of choice (CCH)	Total
GED	Cycle of general education disciplines	0	0	0	0
BD	Cycle of basic disciplines	0	20	5	25
PD	Cycle of profile disciplines	0	10	10	20
Total for theoretical training:		**0**	**30**	**15**	**45**
RWDS	Research Work of Doctoral Student				123
ERWDS	Experimental Research Work of Doctoral Student				0
FA	Final attestation				12
TOTAL:					**180**

Decision of the Educational and Methodological Council of KazNRTU named after K.Satpayev. Minutes № 3 dated 20.12.2024

Decision of the Academic Council of the Institute. Minutes № 4 dated 12.12.2024

Signed:

Governing Board member - Vice-Rector for Academic Affairs	Uskenbayeva R. K.
Approved:	
Vice Provost on academic development	Kalpeyeva Z. Б.
Head of Department - Department of Educational Program Management and Academic-Methodological Work	Zhumagaliyeva A. S.
Director - Mining and Metallurgical Institute named after O.A. Baikonurov	Rysbekov K. .
Department Chair - Materials Science, Nanotechnology and Engineering Physics	Kakimpv U. K.
Representative of the Academic Committee from Employers ____Acknowledged____	Mutushev A. Z.