Mining and Metallurgical Institute named after O.A. Baikonurov

Department of "Materials Science, Nanotechnology and Engineering Physics"

EDUCATIONAL PROGRAM
8D05301 Applied and Engineering Physic

Code and classification of the field of education:
8D05 Natural sciences, mathematics and statistics
Code and classification of training directions:
8D053 "Physical and chemical sciences"
Group of educational programs:
D090 Physics

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 "8D05301 Applied and Engineering Physic" 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 "8D05301 Applied and Engineering Physic" was developed by Academic committee based on direction «8D053 Physical and chemical sciences»

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 for the preparation of a Doctor of Philosophy (PhD) has a scientific and pedagogical orientation and involves fundamental educational, methodological and research training, as well as in-depth study of disciplines in relevant areas of science for the system of higher and postgraduate education. and scientific field. The content of the educational program “Applied and Engineering Physics” was developed based on studying the experience of foreign universities and research centers.

The main criterion for completing the educational process for preparing a Doctor of Philosophy (PhD) (doctor in this field) is that the doctoral student has completed at least 180 academic credits, including all types of educational and scientific activities.

The duration of doctoral studies is determined by the volume of completed academic credits. When mastering the established volume of academic credits and achieving the expected learning outcomes for obtaining a Doctor of Philosophy (PhD) degree or according to the profile, the doctoral educational program is considered to be fully mastered.

Doctoral studies are carried out on the basis of master's programs.

2. Purpose and objectives of educational program

OP goal:

The goal of the educational program is to provide fundamental training for PhD students to successfully solve scientific and engineering problems, develop skills in engineering analysis and design, design and conduct scientific research, including as a leader or team member.

OP tasks:

In accordance with the professional competencies of a Doctor of Philosophy (PhD), trained in the educational program “Applied and Engineering Physics”, the objectives of the program are:

- integrate fundamental training and applied skills to successfully solve scientific and engineering problems in the field of applied physics;
- develop physico-mathematical and physico-chemical methods and processes in order to optimize parameters;
-explore with your own original and modified experimental setups in the field of physics.

3. Requirements for evaluating the educational program learning outcomes

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

Selecting means of assessing learning outcomes The main task at this stage is to select assessment methods and tools for all types of control, with the help of which one can 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	8D05 Естественные науки, математика и статистика
2	Code and classification of training directions	8D053 "Physical and chemical sciences"
3	Educational program group	D090 Physics
4	Educational program name	8D07103 Materials Science and Engineering
5	Short description of educational program	Educational program 8D05301 Applied and engineering physics is the third level of qualification of the three-level higher education system
6	Purpose of EP	The goal of the educational program is to provide fundamental training for PhD students to successfully solve scientific and engineering problems, develop skills in engineering analysis and design, design and conduct scientific research, including as a leader or team member.
7	Type of EP	New
8	The level based on NQF	8
9	The level based on IQF	8
10	Distinctive features of 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	1) Systematize and summarize basic scientific information about objects, technologies and strategies for conducting scientific research based on deep general engineering knowledge in the field of materials science and technology of new materials; 2) Build a research process with the presentation of scientific results in publications of rating journals of international Scopus databases, as well as in national and international peer-reviewed publications; 3) Evaluate technological specifications and process flow diagrams for obtaining modern materials; optimize existing technological production methods based on assessment; 4) Solve technological problems in new and unfamiliar contexts using research, analysis, diagnostics and modeling of the properties of substances and materials;

		5) To predict the conditions and optimization of technological processes for obtaining products with given properties through the integration of interdisciplinary knowledge; 6) Formulate the main problems in the field of materials science and technology of new materials, select methods and means of solving them; 7) Plan and carry out comprehensive research and testing of materials and products, processes of their production, processing and modification; 8) Develop diagrams of modern technological processes of production, processing of materials and products based on them, control systems for technological processes;
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	Methods of scientific research	Goal: formation of knowledge about scientific research, methods and methodology of scientific research, methods of collecting, processing scientific data in modern science. Contents: structure of technical sciences, application of general scientific, philosophical and special methods of scientific research, principles of organization of scientific research, methodological features of modern science, ways of development of science and scientific research, the role of technical sciences, computer science and engineering research in theory and practice.	5		v					v	
Cycle of basic disciplines Component of choice											

3	Sustainability Science.	Goal: To develop in doctoral students a deep understanding of the interactions between natural and social systems, and to develop skills in identifying and developing strategies for sustainable development that promote the long-term well-being of humanity and conservation of the environment. Content: The complex relationships between ecosystems and societies, and delve into the analysis of sustainability issues at local, national and international levels.	5	**v**			**v**				
4	Synthesis and physical properties of low-dimensional structures	The discipline studies the fundamental concepts of solid state physics for low-dimensional systems. The physical processes occurring in these systems under external influences, the properties of low-dimensional structures, production technologies and the use of nanomaterials in modern technology are considered.	5	**v**					**v**		
5	Physics and technology of energy saving and renewable energy	The discipline is devoted to the description and analysis of renewable energy sources, their use in the overall energy balance of the country and regions. The discipline also covers issues of global energy saving in industry, agriculture and housing and communal services. Issues of using secondary energy resources and improving environmental conditions are also considered; technical and economic indicators of the use of renewable energy sources in agriculture; application of resource-saving technologies using renewable energy sources.	5		**v**					**v**	

	Computer modeling of engineering problems	The discipline studies the construction of a mathematical model that describes the process under study and numerical calculation methods. The creation of a program that implements a computational algorithm that calculates and processes the received information is considered. The analysis of calculation results is also studied in comparison with a full-scale experiment.									
7	Methods of computational experiment	The discipline studies the basics of mathematical modeling and computational experiment. The discipline examines the independent development of numerical models for studying complex physical phenomena and processes while conducting research experiments. We study working with a model of an experiment or process, which makes it possible to study the process without high costs and labor-intensive experiments.	5					**v**			
8	Semiconductor heterostructures and devices based on them	The discipline studies a multilayer structure of semiconductors with different band gaps with a thickness of several microns. We consider materials that have the same crystalline structure, where charge carriers move freely across layer boundaries. The concept of a heterojunction and corresponding devices based on this phenomenon are being studied.	5							**v**	
	Physico-chemical methods for studying materials	The purpose of this discipline is to study the fundamentals of the theory and practice of physico-chemical analysis of substances, the basic experimental principles underlying physico-chemical research methods, their connection with modern technologies. 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 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	**D090 - "Physics"**
Educational program	**8D05301 - "Applied and engineering physics"**
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						
PHY319	Physics and technique of saving and renewable energy	1	BD, CCH	5	150	30/0/15	105	E	5						
PHY305	Synthesis and Physical Properties of Low-dimensional Structures	1	BD, CCH	5	150	30/0/15	105	E	5						
MNG350	Sustainability Science	1	BD, CCH	5	150	30/0/15	105	E	5						
M-3. Practice-oriented module															
AAP350	Pedagogical practice		BD, UC	10				R		10					
CYCLE OF PROFILE DISCIPLINES (PD)															
M-2. Module of professional activity															
PHY320	Semiconductor heterostructures and devices based on them	1	PD, CCH	5	150	30/0/15	105	E	5						
PHY301	Methods of computational experiment	1	PD, CCH	5	150	30/0/15	105	E	5						
PHY328	Application of artificial intelligence for computational tasks in physics	2	PD, CCH	5	150	30/0/15	105	E	5						
PHY302	Physicochemical methods of materials research	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.