



**Institute of Energy and Mechanical Engineering named after A. Burkitbayev
Department of Standardization, Certification and Metrology**

**EDUCATIONAL PROGRAM
8D07122 “Engineering Metrology and Standardization in
Mechanical Engineering”**

Code and classification of the field of education: 8D07 Engineering, manufacturing and construction branches

Code and classification of training directions: 8D071 Engineering and engineering trades

Group of educational programs: D103 Mechanics and metal working

Level based on NQF: 8

Level based on IQF: 8

Study period: 3 years

Amount of credits: 180

Almaty 2025

Educational program “Engineering Metrology and Standardization in Mechanical Engineering” was approved at the meeting of K.I. Satbayev KazNRTU Academic Council

Protocol #9 dated «20» February 2025.

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

Protocol #4 dated «3» February 2025.

Educational program “Engineering Metrology and Standardization in Mechanical Engineering” was developed by Academic committee based on direction «8D071 Engineering and engineering trades».

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List of abbreviations and designations

EP - educational program
NQF - national qualification framework
ORK - industry qualification framework
LO - learning outcomes
GED - general education disciplines
DB - basic disciplines
PD - major disciplines
VC - university component
HF - course optional
SDGs - Sustainable Development Goals

1. Description of educational program

The doctoral program "Engineering Metrology and Standardization in Mechanical Engineering" is aimed at training highly qualified specialists capable of solving key tasks and challenges related to the complex development of mechanical engineering production. The program includes mastering modern methods of management and control in enterprises, using information technologies, implementing international standards, general quality management methods, as well as the development and implementation of innovative solutions in the field of environmental protection and advanced technologies. Graduates of the program will have the necessary knowledge and skills to successfully work in a rapidly changing technological landscape and a global competitive environment.

The content of the EP includes an introduction to the basics of engineering metrology and standardization in mechanical engineering, where students learn about the role of metrology and standardization in ensuring product quality, safety, and competitiveness, as well as international and national standards applied in the industry. The program covers the basic principles and methods of measurements, as well as their accuracy and reliability in the context of mechanical engineering production. It also includes the fundamentals of quality management systems, including international standards such as ISO 9001, and methods for implementing quality systems in mechanical engineering enterprises. Topics on product and process certification, as well as the integration of various quality management systems, are also included.

The educational program "Engineering Metrology and Standardization in Mechanical Engineering" prepares specialists who are ready to effectively address tasks related to quality assurance, metrology, and standardization in high-tech areas of mechanical engineering.

The content of the "Engineering Metrology and Standardization in Mechanical Engineering" program has been developed with consideration of the current level of product quality assurance in the mechanical engineering industry of the Republic of Kazakhstan, as well as the identified needs for the development, optimization, and systematization of state standards in Kazakhstan that correspond to current production requirements.

2. Purpose and objectives of educational program

Purpose of EP: The training of professional and scientific personnel with core competencies in scientific creativity and project activities, as well as skills in the fields of engineering standardization and metrology in the mechanical engineering industry, developed through theoretical training and their practical application within the framework of scientific research activities.

Tasks of EP:

1. To develop doctoral students' research skills for quality education (SDG 4) through specialist training, industrialization and innovation (SDG 9) via advanced technologies, economic growth (SDG 8) by creating new jobs, environmentally

friendly production (SDG 12), and international cooperation (SDG 17), contributing to Kazakhstan's technological development in mechanical engineering;

2. Development of practical skills and knowledge in metrology, standardization, and quality management in mechanical engineering for quality education (SDG 4) through specialist training, industrialization and innovation (SDG 9) via modern standardization methods, economic growth (SDG 8) by enhancing competitiveness, responsible production (SDG 12) through precise quality management systems, and international cooperation (SDG 17) via integration with global standards;

3. Development of skills in performing professional tasks related to the norms and requirements of standards, as well as generating ideas for the continuous improvement of product quality in mechanical engineering;

4. To refine the ability to create forward-looking and innovative normative and technical documents in the field of alternative energy and mechanical engineering with the aim of establishing standards aimed at improving product quality and optimizing processes;

5. To expand the skills in applying and implementing standards in testing laboratories for managing the quality of laboratory research and the results of analyzing various study objects in the field of mechanical engineering;

6. To develop the ability to implement and apply quality management standards for the use of efficient resource-saving technologies in environmental monitoring at an enterprise.

3. Requirements for evaluating the educational program learning outcomes

The educational program was developed in accordance with the State Compulsory Standards of Higher and Postgraduate Education, approved by order of the Minister of Science and Higher Education of the Republic of Kazakhstan dated July 20, 2022 No. 2 (registered in the Register of State Registration of Normative Legal Acts under No. 28916) and reflects the learning results, based on which develop curricula (working curricula, individual curricula for students) and working curricula for disciplines (syllabuses).

Assessment of learning outcomes is carried out based on developed tasks within the educational program in accordance with the requirements of the state compulsory standard of higher and postgraduate education.

When assessing learning outcomes, uniform conditions and equal opportunities are created for students to demonstrate the level of their knowledge, skills and abilities.

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 branches

2	Code and classification of training directions	8D071 Engineering and engineering trades
3	Educational program group	D103 Mechanics and metal working
4	Educational program name	Engineering Metrology and Standardization in Mechanical Engineering
5	Short description of educational program	The educational program is designed to train highly qualified specialists capable of solving key tasks and challenges related to the comprehensive development of mechanical engineering production. The program includes mastering modern management and control methods in enterprises, using information technologies, implementing international standards, general quality management methods, as well as the development and implementation of innovative solutions in the field of environmental protection and advanced technologies. Graduates of the program will possess the necessary knowledge and skills to successfully work in a rapidly changing technological landscape and a global competitive environment.
6	Purpose of EP	Training of professional and scientific personnel with core competencies in scientific creativity and project activities, as well as skills in engineering standardization and metrology fields in the mechanical engineering industry, developed through theoretical training and their practical application within the framework of scientific research activities.
7	Type of EP	Innovative 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	<i>General competencies:</i> • Knowledge of English to search for scientific and technical information; work with scientific and technical literature in a technical area. • Possession of skills: independent learning; deepening your knowledge; be open to new information; systems thinking and personal judgment. • Ability to carry out assigned tasks that arise in the process of research and teaching activities. • Possession of communication skills, ability to collaborate and work in a scientific team. • Possession of a broad social, political and professional outlook; ability to use data from various sources and specialized literature, analyze and critically evaluate. • Possession of analytical thinking, logic, analysis skills, as well as personal self-expression and self-development skills. <i>Professional competencies:</i> • The ability to use research methods, analyze the technical and economic efficiency of research and development in engineering standardization to improve the mechanical engineering market.

		• The ability to select objects for standardization, necessary methods and research techniques in accordance with the objectives of a specific study in the mechanical engineering industry. • The ability to implement modern scientific and technical achievements, best practices both in Kazakhstan and abroad, in the field of standardization and metrology. • The ability to create modern quality management systems for technological processes in mechanical engineering production, incorporating advanced technologies to achieve the best results. • Proficiency in conducting patent research, licensing, and protecting intellectual property rights when creating innovative products in professional activities. • Mastery of physical and technical knowledge to solve complex problems in standardization and metrology during product manufacturing. • The skill to assess trends in the development of state standardization, taking into account international standards and regulations.
12	Learning outcomes of educational program	LO1 – To apply standardization to enhance production efficiency, product quality and safety, and for development of innovations and sustainable infrastructure (SDG 9). LO2 – To analyze and advance theoretical and methodological approaches in the field of standardization by developing and substantiating innovative scientific concepts aimed at the transformation and evolution of standards in the context of technological and socio-economic dynamics. LO3 – To develop and introduce own research and teaching strategies in the field of standardization and metrology, integrating digital technologies to enhance scientific knowledge, educational practices, and also for transformation of professional standards. LO4 – To apply methodological and methodical approaches to assess the effectiveness of international, national, regional, and sectoral development programs in standardization, certification, metrology, and quality management. LO5 – To analyze experimental data and develop methods for physico-technical evaluation of engineering objects in accordance with the requirements of the Unified System for Technological Documentation (USTD) and the Unified System for Design Documentation (USDD) when presenting research results. LO6 – To solve theoretical and applied problems through comprehensive analysis of the research object, considering international standards, promoting harmonization of regulatory frameworks, intersectoral

		cooperation development, and support for scientific and technological initiatives (SDG 17). LO7 – To apply a methodological foundation for planning, organizing, and implementing scientific research, including topic selection, setting goals and objectives, data collection and analysis methods, and presenting results in accordance with academic and professional standards. LO8 – To apply methods and methodology of scientific research, principles of organization the scientific research, and to develop academic writing skills and strategies for written communication.
13	Education form	intramural
14	Period of training	3 years
15	Amount of credits	180
16	Languages of instruction	Kazakh, Russian, English
17	Academic degree awarded	Doctor of Philosophy (PhD)
18	Developer(s) and authors	Omarova Zhansaya, PhD, Associate Professor. Tatybayev Mukhtarbek, Candidate of pedagogical sciences, Deputy Director of the A. Burkitbaev Institute of Energy and Mechanical Engineering.

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)							
				LO1	LO2	LO3	LO4	LO5	LO6	LO7	LO8
Cycle of basic disciplines University component											
1	Methods of scientific research	Purpose: It consists in mastering knowledge about the laws, principles, concepts, terminology, content, specific features of the organization and management of scientific research using modern methods of scientometry. 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
2	Academic writing	Objective: to develop academic writing skills and writing strategies for doctoral students in engineering and natural sciences. Content: fundamentals and general principles of academic writing, including: writing effective sentences and paragraphs, writing an abstract, introduction, conclusion, discussion, and references; in-text citation; preventing plagiarism; and preparing a conference presentation.	5			v				v	v
Cycle of basic disciplines Component of choice											

3	Integration of quality standards and innovative technologies	Purpose: formation of knowledge, skills, and competencies in integrating quality management and innovation to enhance organizational competitiveness, ensure sustainable development (SDG 8, 9, 12), improve product and service quality (SDG 4, 6), increase resource and energy efficiency (SDG 7, 13), and foster international cooperation and the implementation of advanced standards (SDG 17) to achieve strategic organizational goals. Content: the discipline develops doctoral students' understanding of the theory, models, and standards of quality management, as well as their impact on quality education (SDG 4) through specialist training, industrialization and innovation (SDG 9) through modern standards, and responsible consumption and production (SDG 12) by improving process efficiency and environmental sustainability..	5	v					v		
4	Sustainability Science	Objective: to develop a deep understanding among doctoral students of the interactions between natural and social systems, as well as to develop skills for identifying and developing strategies for sustainable development that promote long-term human well-being and environmental preservation. Content: complex interconnections between ecosystems and societies, as well as an in-depth analysis of sustainability issues at local, national, and international levels.	5			v	v				
5	Pedagogical practice	Pedagogical practice in doctoral studies is aimed at developing the competencies necessary for organizing and managing the educational process. It also aims to develop practical skills in the field	15			v				v	v

		of teaching and learning methods in higher education.									
Cycle of profile disciplines University component											
6	Research practice	The purpose of research practice is to systematize, expand and strengthen professional knowledge. In addition, it is aimed at developing doctoral students' skills in conducting independent scientific work, conducting research and experiments as part of their doctoral dissertation.	20			v		v	v		v
Cycle of profile disciplines Component of choice											
7	Digitization of mechanical engineering processes and standards for managing production data	Purpose: Train doctoral students in the fundamentals of digitalization of manufacturing processes, the implementation and application of modern information technologies for managing production data, and familiarize them with international and national standards in this field. Content: The fundamental principles and technologies of digitalization in mechanical engineering, including information systems (MES, ERP, PLM) and CAD/CAM/CAE, contribute to quality education (SDG 4) through specialist training, economic growth and decent work (SDG 8) by automating processes, industrialization and innovation (SDG 9) through digital technologies, and responsible production (SDG 12) by improving resource efficiency. They also ensure the study of international and national standards (including ST KZ) and methods for integrating digital technologies to enhance production safety and efficiency.	5				v				
8	Technical regulations and	Purpose: To provide doctoral students with knowledge of the principles and procedures for	5		v						

	certification of mechanical engineering products	certifying mechanical engineering products in accordance with national and international standards, as well as to familiarize them with the main technical regulations and requirements governing the production and operation of products. Content: Study of the regulatory and legal framework in the field of technical regulation, types and methods of certification, as well as the specifics of applying quality and safety standards for mechanical engineering products, which is necessary to ensure compliance with product requirements of consumers and legislation.								
9	Experimental methods in standardization and metrology in mechanical engineering	Purpose: Study of current issues and prospects for improving the efficiency of statistical quality management in mechanical engineering products and methods for processing experimental data. Content: Study of the regulatory and legal framework in the field of technical regulation, types and methods of certification, as well as the specifics of applying quality and safety standards for mechanical engineering products, which is essential to ensure product compliance with consumer requirements and legislation.	5					v		

10	Standardization and quality assurance of scientific and production activities	Purpose: preparing doctoral students to solve organizational, scientific, technical and legal problems of quality management, the basics of certification and assessing the effectiveness of scientific and production activities. Content: the role of standards in the quality management process, production efficiency metrics based on data analysis and their application in the scientific and production sphere, quality management system, quality standards, certification procedures, methods for assessing the effectiveness of business processes.	5		✓		✓				
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5. Curriculum of educational program

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



«APPROVED»
Decision of the Academic Council
NPJSC «KazNRTU»
named after K.Satbayev»
dated 20.02.2025 Minutes № 9

WORKING CURRICULUM

Academic year 2025-2026 (Autumn, Spring)
Group of educational programs D103 - "Mechanics and metal working"
Educational program 8D07122 - "Engineering Metrology and Standardization in Mechanical Engineering"
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)																	
Module of basic training																	
MET322	Methods of scientific research		BD, UC	5	150	30/0/15	105	E	5								
LNG305	Academic writing		BD, UC	5	150	0/0/45	105	E	5								
MNG350	Sustainability Science	1	BD, CCH	5	150	30/0/15	105	E	5								
Practice-oriented module																	
AAP350	Pedagogical practice		BD, UC	10				R		10							
CYCLE OF PROFILE DISCIPLINES (PD)																	
Module of basic training																	
ISO309	Integration of quality standards and innovative technologies	1	PD, CCH	5	150	30/0/15	105	E	5								
Module of professional activity																	
ISO306	Digitization of mechanical engineering processes and standards for managing production data	1	PD, CCH	5	150	30/0/15	105	E	5								
ISO307	Technical regulations and certification of mechanical engineering products	1	PD, CCH	5	150	30/0/15	105	E	5								
ISO308	Experimental methods in standardization and metrology in mechanical engineering	2	PD, CCH	5	150	30/0/15	105	E	5								
ISO305	Standardization and quality assurance of scientific and production activities	2	PD, CCH	5	150	30/0/15	105	E	5								
Practice-oriented module																	
AAP355	Research practice		PD, UC	10				R			10						
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			
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			

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named after K.I.SATBAYEV»**

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	0	20
PD	Cycle of profile disciplines	0	10	15	25
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 № 4 dated 03.02.2025

Decision of the Academic Council of the Institute. Minutes № 3 dated 19.12.2024

Signed:

Governing Board member - Vice-Rector for Academic Affairs

Uskenbayeva R. K.

Approved:

Vice Provost on academic development

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Head of Department - Department of Educational Program
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Director of the Institute - A.Burkitbaev Institute of Energy
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Representative of the Academic Committee from Employers
____ Acknowledged _____

Aymagambetova R.

