



**Institute of Energy and mechanical engineering named after A. Burkitbayev
Department of Standardization, certification and metrology**

**EDUCATIONAL PROGRAM
7M07502 Metrology (by industry)**

Code and classification of the field of education: 7M07 Engineering,
manufacturing and construction industries

Code and classification of training directions: 7M075 Standardization, certification
and metrology (by industry)

Group of educational programs: M130 Standardization, certification and metrology
(by industry)

Level based on NQF: 7

Level based on IQF: 7

Study period: 2 y.

Number of credits: 120

Almaty 2024

Educational program was approved at the meeting of K.I. Satbayev KazNRTU Academic Council

Protocol # 12 dated « 22 » 04 2024.

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

Protocol # 6 dated « 19 » 04 2024 .

Educational program was developed by Academic committee based on direction «7M075 Standardization, certification and metrology (by industry)»


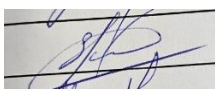


Full name	Academic degree/ Academic title	Position	Workplace	Signature
Chairperson of Academic Committee:				
Aimagambetova Raushan	Master's degree	Head of the Department of Strategic Development and Sciences, «KazStandard»	Republican State Enterprise "KazStandard"	
Teaching staff:				
Yerezhep Darkhan	Candidate of technical sciences, PhD	Head of Department of Standardization, certification and metrology department	NJSC "KazNRTU after K.I. Satpayev", +7 777 346 8621	
Karazhanova Dariga	Candidate of Pedagogical Sciences	Associate professor of Standardization, certification and metrology department	KazNRTU named after K.I.Satpayev	
Students				
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List of abbreviations and designations

EP – Educational program
NQF – national qualifications framework
IQF – industry qualification framework
ER – education results
BD – basic disciplines
PD – profile disciplines
UC – University component
CC – Component of choice

1. Description of educational program

Master's educational program 7M07502 - "Metrology (by industry)" includes fundamental, natural science, general engineering and professional training of undergraduates in the field of metrology, who have theoretical knowledge and practical skills in professional training in the field of industrial metrology, quality management systems, verification and calibration. It is an educational program in the scientific and pedagogical direction of training and is designed for 2 years of study. The study lasts four semesters, culminating in a Master of Engineering degree, which imparts in-depth knowledge and develops advanced skills for use in a changing and competitive environment.

This EP trains competitive personnel in the field of metrology, focused on ensuring the reliability of measurement results, quality and safety of products and services, with in-depth professional competencies in the development and implementation of regulatory and technical documentation, quality management systems, and testing of measuring instruments.

2. Purpose and objectives of educational program

Purpose of the EP: Training of competitive personnel in the field of metrology, focused on ensuring the reliability of measurement results, quality and safety of products and services, with in-depth professional competencies in the development and implementation of regulatory and technical documentation, quality management systems, testing of measuring instruments.

EP tasks:

1. To develop the student's competencies in managing material and information flows in the production of products and provision of services under conditions of universal metrological control;
2. To develop the student's competence to carry out the actions necessary for effective work in the field of metrology;
3. To develop in students teamwork skills, production and ethical responsibility, the ability to work and communicate with various specialists and the need to improve their knowledge and skills;
4. To develop in the student the ability to carry out control and testing during the production process;
5. To develop the student's ability to carry out metrological support activities.

3. Requirements for evaluating the educational program learning outcomes

At the final stage of master's preparation, it is envisaged to complete and defend a master's thesis.

The academic disciplines in which a master's thesis is to be defended are determined by the current state compulsory standards of higher professional education.

The master's thesis is the result of independent research under the guidance of a supervisor.

The master's thesis is defended at a meeting of the State Attestation Commission.

The final state certification of students is carried out in accordance with the Rules for ongoing monitoring of academic performance, intermediate and final state certification of students in educational organizations.

Persons who have fully completed the curriculum for the educational and professional program of higher basic education with the completion of at least 120 academic credits of theoretical training and a final master's thesis, who have successfully defended a master's thesis, are issued a diploma of higher education with the assignment of qualifications and the award of the academic degree "Master of Technical Sciences" .

The graduate is also given a diploma supplement, which includes final examination and test grades in the disciplines studied, an assessment for the defense of the master's thesis, indicating the topic of the master's thesis.

4. Passport of educational program

4.1. General information

№	Field name	Comments
1	Code and classification of the field of education	7M07 Engineering, manufacturing and construction industries
2	Code and classification of training directions	7M075 Standardization, certification and metrology (by industry)
3	Educational program group	M130 Standardization, certification and metrology (by industry)
4	Educational program name	Metrology (by industry)
5	Short description of educational program	Educational program 7M07502 – “Metrology (by industry)” includes fundamental, natural science, general engineering and professional training of undergraduates in the field of metrology, who have theoretical knowledge and practical skills in professional training in the field of industrial metrology, quality management systems, verification and calibration.
6	Purpose of EP	Training of competitive personnel in the field of metrology, focused on ensuring the reliability of measurement results, quality and safety of products and services, with in-depth professional competencies in the development and implementation of regulatory and technical documentation, quality management systems, testing of measuring instruments.
7	Type of EP	Active
8	The level based on NQF	7
9	The level based on IQF	7
10	Distinctive features of EP	No
11	List of competencies of educational program	General competencies: <ul style="list-style-type: none"> • Proficiency in English for: searching for scientific and technical information; working with scientific and technical literature; oral and written communication with a native speaker on professional topics and in real life situations. • Possession of critical systems thinking, transdisciplinarity and cross-functionality. • Possession of ICT competencies, ability to develop software using algorithmic languages.

		<ul style="list-style-type: none"> • Possession of skills: independent learning; deepening your knowledge; be open to new information; systems thinking and personal judgment. • The ability to be tolerant of another nationality, race, religion, culture; ability to conduct intercultural dialogue. • Possession of communication skills, ability to collaborate and work in a team. • Ability to work in conditions of high uncertainty and rapidly changing task conditions; work with consumer requests. • Possession of a broad social, political and professional outlook; • Ability to use data from various sources and specialized literature, analyze and critically evaluate historical facts and events. • Knowledge of the basics of entrepreneurship and business economics, readiness for social mobility. <p>Professional competencies:</p> <ul style="list-style-type: none"> • Possession of skills in analyzing the causes of nonconformities; • Possesses the skills of generating management decisions in the field of metrology in technical systems; • Has the skills to independently solve problems in the field of metrology based on the latest achievements of science and technology; • Has the skills to determine the forms and methods of legal protection and defense of rights to the results of intellectual activity; • Has the skills to develop and improve processes in relation to metrology problems; • Has the skills to reduce risks in quality assurance systems; • Has the skills to implement changes in quality assurance systems to maintain quality; • Possesses management skills in the creation of methodological and regulatory documents in the field of metrology.
12	Education outcomes of educational program	<p>EO 1 – Use knowledge to apply methods of intellectual property protection in the Republic of Kazakhstan</p> <p>EO 2 – Use the ability to carry out calculations to estimate errors, uncertainty of measurement results, to determine the requirements for factors affecting the measurement error (uncertainty).</p> <p>EO 3 – Use the acquired knowledge, skills and qualifications for carrying out work on metrological support of production, testing and operation of measuring instruments.</p>

		<p>EO 4 – To use the skills and abilities of developing verification methods, calibration methods, certification methods, test methods of measuring instruments, measurement methods.</p> <p>EO 5 – Master the basics of philosophical, legal and critical thinking with application in life.</p> <p>EO 6 – Use communication skills in professional and interpersonal relationships.</p> <p>EO 7 – To use the acquired knowledge for the organization of work on preparation for the accreditation of laboratories.</p> <p>EO 8 – Use the skills of an innovative approach to participate in the development of projects and planned tasks for the introduction of new measuring equipment, organizational and technical measures to improve production efficiency.</p> <p>EO 9 – Use the acquired knowledge to improve the legal framework of metrological activities, further development of metrological services, use and implementation of international experience.</p> <p>EO 10 – Use the acquired knowledge to monitor the condition and application of standards, measuring instruments, test equipment, standard samples.</p>
13	Education form	Full-time
14	Period of training	2 years
15	Amount of credits	120
16	Languages of instruction	Kazakh, russian, english
17	Academic degree awarded	Master of technical sciences
18	Developer(s) and authors	Aymagambetova R. head of department, “Kazstandard”;
		Yerezhep D., head of the department SS&M
		Karazhanova D. Assoc. prof. of the department SS&M
		Baibol A., master’s student, 1 year

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

№	Discipline name	Short description of discipline	Number of credits	Generated education outcomes (codes)									
				EO1	EO2	EO3	EO4	EO5	EO6	EO7	EO8	EO9	EO10
Basic disciplines cycle University component													
1.	Foreign language (professional)	Purpose: to improve and develop foreign language communication skills in the professional and academic field. Content: general principles of professional and academic intercultural oral and written communication using modern pedagogical technologies (round table, debates, discussions, analysis of professionally oriented cases, design).	3	v									
2.	History and philosophy of science	Purpose: to explore the history and philosophy of science as a system of concepts of global and Kazakh science. Content: the subject of philosophy of science, dynamics of science, the main stages of the historical development of science, features of classical science, non-classical and post-non-classical science, philosophy of mathematics, physics, engineering and technology, specifics of engineering sciences, ethics of science, social and moral responsibility of a scientist and engineer.	3		v								
3.	Higher school pedagogy	Purpose: to learn how to solve scientific and pedagogical problems, taking into account new technologies in the field of higher education. Content: methodological and theoretical foundations of higher school pedagogy, modern pedagogical technologies, planning and organization of learning and upbringing processes, the use of communicative technologies of subject-subject interaction between a teacher and a student in the educational process of a university, human resource management in higher educational institutions.	3					v					
4.	Psychology of management	Purpose: to acquire skills in making strategic and managerial decisions, taking into account the psychological characteristics of the individual and the team. Content: the modern role and content of psychological aspects in management activities, methods for improving psychological literacy, the composition and structure of management activities, both at the local and foreign levels, the psychological feature of modern managers.	3		v								
Cycle of basic disciplines Component of choice													

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5.	Copyright protection in the field of metrology	Purpose: to investigate and employ strategies for safeguarding intellectual property within the realm of metrology. It aims to analyze current challenges pertaining to metrological protection of intellectual property in the Republic of Kazakhstan. Content: encompasses the examination and application of methodologies for protecting intellectual property in metrology. It also involves the study of contemporary issues surrounding the metrological safeguarding of intellectual property within the specific context of the Republic of Kazakhstan.	5				v				v		
6.	Intellectual property and research	The purpose of this course is to provide undergraduates with the knowledge and skills necessary to understand, protect and manage intellectual property (IP) in the context of scientific research and innovation. The course is aimed at training specialists who can effectively work with IP, protect the results of scientific research and apply them in practice.	5				v						
7.	Commercialization of new technologies in metrology	Purpose: to explore the commercialization system within the Republic of Kazakhstan, to analyze methods for developing and implementing new technologies in the enhancement and advancement of production technologies. Content: examination of the commercialization framework in Kazakhstan, with particular emphasis on the operations of the National Agency for Technological Development. Involves studying strategies for the development and integration of innovative technologies, as well as exploring contemporary directions for enhancing and refining production technologies.	5		v								
8.	Metrological support of enterprises (by industry)	Purpose: to delve into the principles of technical control, measurement instruments, and the process of control. It aims to enhance the mechanisms facilitating departmental collaboration to ensure measurement uniformity and metrological support across various sectors of the economy. Content: entails the exploration of technical control principles, measurement instrument functionalities, and control methodologies. It also focuses on refining interdepartmental coordination to maintain measurement consistency and provide metrological assistance across diverse economic sectors.	5	v					v				
9.	Planning and organization of innovation activities	Purpose: to explore techniques for devising and structuring an action plan aimed at implementing novel methodologies to enhance organizational (or enterprise) performance. Content: delves into the study of methodologies for developing and coordinating action programs designed to introduce innovative approaches aimed at optimizing organizational efficiency.	5				v						v

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10.	Sustainable development strategies	The purpose of this course is to provide master's students with in-depth knowledge and practical skills to develop, implement and manage strategies aimed at achieving sustainable development. The course content covers the following topics: fundamentals of sustainable development, economic aspects of sustainable development, social aspects of sustainable development, development of sustainable development strategies, innovation and technology in sustainable development, ethics and sustainable development, prospects and future of sustainable development.	5					v						
Cycle of profile disciplines University component														
11.	Accreditation of testing and calibration laboratories according to GOST ISO/IEC 17025	Purpose: to establish the general prerequisites for the competency of testing and calibration laboratories. It further seeks to elucidate the accreditation process for such laboratories, including testing, verification, and calibration centers. Content: encompasses defining the essential criteria for ensuring the competence of testing and calibration laboratories. It delves into the accreditation procedures applicable to testing, verification, and calibration facilities. The course examines the hierarchical arrangement and functions of the accreditation body operating within the Republic of Kazakhstan.	5					v		v				
12.	Mathematical processing of verification and calibration results	Purpose: to explore techniques for statistically processing measurement and test results. It is designed to provide students with an understanding of statistical methods for estimating distribution parameters and constructing multiple linear correlation models. Content: covers methods for estimating distribution parameters, such as mean and variance, and explores the construction of multiple linear correlation models to analyze relationships between variables. Through this course, students will gain proficiency in statistical analysis applicable to various fields of measurement and testing.	5				v							v
13.	Metrological examination and accreditation	Purpose: To impart knowledge and skills related to the assessment and certification of measurement processes, principles of metrology, calibration methods and compliance with standards necessary to ensure accurate and reliable measurements. Content: metrological principles, calibration techniques and examination and accreditation procedures. The importance of measurement accuracy, traceability and the role of regulators in ensuring compliance with international standards. Practical exercises and case studies are included to reinforce learning.	4					v						
14.	Quality assurance of measurements in laboratories	Purpose: to uphold the accuracy and impartiality of measurements by focusing on methods to ensure reliability and objectivity. It aims to equip learners with the skills to evaluate measurement results and ascertain their uncertainty. Content: covers strategies and techniques to	5				v							

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		maintain the reliability and objectivity of measurements. It delves into the evaluation of measurement outcomes and the assessment of their uncertainty. Furthermore, the course explores methods for estimating input values and determining their standard deviations.											
15.	Patent-licensing activity	Purpose: to enable students to identify and acquire patents for inventions, utility models, or industrial designs. It focuses on understanding the conditions necessary for the patentability of industrial property objects. Content: the conditions and criteria for determining the patentability of objects. Additionally, the course delves into the procedures and requirements involved in obtaining patents, providing students with practical knowledge and skills in navigating the patenting process.	5				v						
16.	Applied, regulatory and methodological aspects of verification and calibration	Purpose: to examine the system of verification and calibration for measuring instruments in Kazakhstan. It aims to familiarize students with the ILAC policy concerning the traceability of measurement results Content: encompasses a comprehensive study of the verification and calibration system for measuring instruments in Kazakhstan. It includes an overview of the ILAC policy focusing on traceability and the standards set forth by the BIPM for determining calibration frequencies.	5								v		
17.	Traceability of measurements	Purpose: To understand and determine the metrological traceability of measurement results, ensuring the accuracy and reliability of measurements in scientific and industrial applications. Content: studying the BIPM traceability chain, measurement uncertainty, and their roles in quality management. Explore standards, certification procedures, and data-driven decision-making, including modules on performance metrics, data analysis, and managing processes based on data insights.	5			v							
18.	Development of the reference base	Purpose: to examine the reference base of the Republic of Kazakhstan and the state system established to ensure measurement uniformity, to explore methods for both quantitative and qualitative advancement and enhancement of the reference base within the republic. Content: encompasses an in-depth study of the reference base of Kazakhstan, including its establishment and maintenance. Additionally, the course covers strategies for both quantitative and qualitative development and improvement of the reference base.	5					v					
19.	Development and certification of measurement techniques	Purpose: to delve into the methodologies for developing and certifying measurement techniques. It aims to elucidate the sequence for applying these techniques and the process of metrological control over measurement methods. Content: encompasses the study of techniques for developing and certifying measurement methods. It also includes	5					v			v		

		the exploration of the order in which these techniques are applied and the procedures involved in metrological control to ensure the accuracy and reliability of measurement methods.												
Cycle of profile disciplines Component of choice														
20.	Conducting interlaboratory comparisons in accordance with GOST ISO/IEC 17043	Purpose: to investigate and assess the effectiveness and comparability of test or measurement methods. To equip students with the skills to evaluate method characteristics and identify differences between laboratories. Content: examination of various test or measurement methods, focusing on their effectiveness and comparability. Techniques for evaluating method characteristics and discerning disparities between different laboratory practices. Analyzing and comparing test or measurement methods, thereby enhancing students' ability to make informed decisions in laboratory settings.	5											
21.	Modern aspects of development of metrology	Purpose: to explore contemporary developments in metrology that address the material, social, and cultural needs of the present era. The evolution of methods for determining measurement accuracy, establishing unity, and creating standards and exemplary measuring instruments. Content: modern aspects of metrology, highlighting advancements that cater to current material, social, and cultural demands. Development of techniques for assessing measurement accuracy, fundamentals of ensuring unity in measurements, and the process of creating standards and exemplary measuring instruments.	5											

5. Curriculum of educational program



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APPROVED
Chairman of the Management Board -
Rector of Satbayev University
M.M. Begentaev
2024 y.

CURRICULUM
of Educational Program on enrollment for 2024-2025 academic year

Educational program 7M07502 – "Metrology (by industry)"
Group of educational programs M130 – "Standardization, certification and metrology (by industry)"

Form of study: full-time

Duration of study: 2 year

Academic degree: Master of Engineering Science

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			
								1 course		2 course	
								1 semester	2 semester	3 semester	4 semester
CYCLE OF BASIC DISCIPLINES (BD)											
M-1. Module of basic training (university component)											
LNG210	English (professional)	BD UC	5	150	0/0/3	105	E	3			
HUM214	Management Psychology	BD UC	3	90	1/0/1	60	E	3			
HUM212	History and philosophy of science	BD UC	3	90	1/0/1	60	E		3		
HUM213	Higher school pedagogy	BD UC	3	90	1/0/1	60	E		3		
component of choice											
SCM200	Metrological support of enterprises (by industry)										
MNG782	Sustainable development strategies	BD CCH	5	150	2/0/1	105	E	5			
SCM205	Commercialization of new technologies in metrology										
SCM202	Copyright protection in the field of metrology	BD CCH	5	150	2/0/1	105	E	5			
SCM203	Planning and organization of innovation activities										
MNG781	Intellectual Property and Research	BD CCH	5	150	2/0/1	105	E			5	
CYCLE OF PROFILE DISCIPLINES (PD)											
M-2. Module of professional activity (university component, component of choice)											
SCM204	Modern aspects of development of metrology	PD CCH	5	150	2/0/1	105	E	5			
SCM206	Conducting interlaboratory comparisons in accordance with GOST ISO/IEC 17043	PD UC	5	150	2/0/1	105	E	5			
SCM207	Quality assurance of measurements in laboratories	PD UC	5	150	2/0/1	105	E		5		
SCM208	Accreditation of testing and calibration laboratories according to GOST ISO/IEC 17025	PD UC	5	150	2/0/1	105	E		5		
SCM209	Patent-licensing activity	PD UC	5	150	2/0/1	105	E		5		
SCM210	Mathematical processing of verification and calibration results	PD UC	5	150	2/0/1	105	E			5	
SCM211	Development of the reference base	PD UC	5	150	2/0/1	105	E		5		
SCM212	Applied, regulatory and methodological aspects of verification and calibration	PD UC	5	150	2/0/1	105	E		5		
SCM213	Traceability of measurements	PD UC	5	150	2/0/1	105	E			5	
ISO265	Metrological examination and accreditation	PD UC	4	120	2/0/1	75	E				4
SCM214	Development and certification of measurement techniques	PD UC	5	150	2/0/1	105	E			5	
M-3. Practice-oriented module											
AAP229	Pedagogical practice	BD UC	6								8
AAP256	Research practice	PD UC	4								4
M-4. Experimental research module											
AAP268	Master's student's research work, including internship and master's thesis	RWMS	4						4		
AAP268	Master's student's research work, including internship and master's thesis	RWMS	4							4	
AAP251	Master's student's research work, including internship and master's thesis	RWMS	2								2
AAP255	Master's student's research work, including internship and master's thesis	RWMS	14								14
M-5. Module of final attestation											
ECA212	Registration and protection of the master thesis	FA	8								8
Total based on UNIVERSITY:								30	30	30	30
								60	60	60	60

Cycle code	Cycles of disciplines	Credits		
		university component (UC)	component of choice (CCH)	Total
BD	Cycle of basic disciplines	20	15	35
PD	Cycle of profile disciplines			53
	Total for theoretical training:	0	15	88
	RWMS			24
FA	Final attestation	8		8
	TOTAL:	8	15	120

Decision of the Academic Council of Kazntu named after K.Satpayev. Protocol № 22.04.2024 y.

Decision of the Educational and Methodological Council of Kazntu named after K.Satpayev. Protocol № 6.19.04.2024 y.

Decision of the Academic Council of the Institute EME, Protocol № 4 or "19" 01.2024.

Board Member - Vice-Rector for Academic Affairs

Uskenbayeva R.

Director of Institute of Energy and Mechanical Engineering named after A. Burkitbayev

Yelesov K.

Head of Department of Standardization, certification and metrology

Yerezhap D.

Specialty Council representative from employers

Aymagambetova R.