Institute of Geology and Oil and Gas Engineering named after K. Turyssov
Department of Geophysics and Seismology

PASSPORT
OF THE EDUCATIONAL PROGRAM
7M05304 - «Applied Seismology»

Code and classification of the area of education: **7M05 «Natural sciences, mathematics, and statistics »**
Code and classification of training directions: **7M053 «Physical and Chemical Sciences»**
Group of educational programs: **M091 «Seismology»**

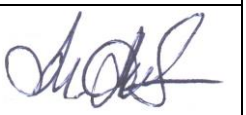
Level according to NQF: 7
Level according to EQF: 7
Duration of study: 1 year
Volume of credits: 60

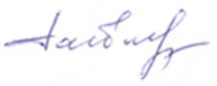
Almaty 2025

The educational program 7M05304 – «Applied Seismology» was approved at the meeting of the Academic Council of KazNTU named after K.I. Satpaev.
Protocol № 9, «20» February 2025 y.

It was reviewed and recommended for approval at the meeting of the Educational and Methodological Council of KazNTU named after K.I. Satpaev.
Protocol № 4, «3» February 2025 y.

The educational program 7M05304 – «Applied Seismology» was developed by the academic committee for the training direction 7M053 «Physical and Chemical Sciences»:

Full name	Academic degree/academic title	Position	Workplace	Signature
Chairman of the Academic Committee:				
Istekova Sara amanzholovna	Doctor of Geological and Mineralogical Sciences	Professor	NJSC "Kazakh National Research Technical University named after K.I.Satpayev"	
Teaching staff:				
Boranbai Tovbasarovich Ratov	Doctor of Technical Sciences, Professor	Head of the Department of Geophysics and Seismology	Kazakh National Research Technical University named after K.I.Satpayev	
Abetov Auez Egemberdievich	Doctor of Geological and Mineralogical Sciences	Professor	Kazakh National Research Technical University named after K.I.Satpayev	
Umirova Gulzada Kubashevna	Doctor of PhD	Associate Professor	Kazakh National Research Technical University named after K.I.Satpayev	
Temirkhanova Raushan Galimzhanovna	Doctor of PhD	Associate Professor	Kazakh National Research Technical University named after K.I.Satpayev	
Siylkhanova Akkenje Orishanovna	Doctor of PhD	Senior Teacher	Kazakh National Research Technical University named after K.I.Satpayev	
Aliakbar Madiyar Manarbekuly	Master of Technical Sciences	Senior Teacher	Kazakh National Research Technical University named after K.I.Satpayev	
Employers:				
Mikhailova Natalia Nikolaevna	Doctor of Physical and Mathematical Sciences	Director	Kazakhstan National Data Center (KNDC)	

Uzbeks Nursarsen Bolataevich	Candidate of Physical and Mathematical Sciences	Deputy Director of Science	Institute of Seismology	
Students				
Dosymbekova Zhansaya	Master of Technical Sciences	Doctoral student 2 years of study	Institute of Seismology	
Isagali Asem	Master of Technical Sciences	Doctoral student 2 years of study	Kazakhstan National Data Center (KNDC)	
Muzapparova Akerke Bakbergenovna	Master of Technical Sciences	Doctoral student 1 years of study	Kazakh National Research Technical University named after K.I.Satpayev	

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List of Abbreviations and Notations

B – Basic knowledge, skills, and competencies
HEI – Higher Education Institution
NAO "KazNTU named after K.I. Satpaev" – Non-profit Joint Stock Company "Kazakh National Research Technical University named after K.I. Satpaev"
MOES of RK – Ministry of Education and Science of the Republic of Kazakhstan
NQF – National Qualifications Framework
R&D – Research and Development
G – General human, social-ethical competencies
NQF – Sectoral Qualifications Framework
PC – Professional competencies
LO – Learning outcomes of the educational program
S – Special and managerial competencies
NCSSN – National Scientific Center of Seismological Observations and Research
IGI NNC – Institute of Geophysical Researches of the National Nuclear Center of the Republic of Kazakhstan
MES – Ministry of Emergency Situations
DS – Department of Emergency Situations
CSE – Commission for Prevention and Liquidation of Emergency Situations
EP – Educational program
BD – Basic discipline
PD – Profiling discipline
VC – University component
EC – Elective component
IA – Final assessment
R&D – Master's research work

1. Description of the Educational Program

The master's program 7M05304 -«Applied Seismology» is aimed at in-depth study of fundamental disciplines, the development of abstract thinking, and unconventional analysis. During the course of study, students will develop skills to adapt to new conditions, rethink accumulated knowledge, and generate new ideas based on seismogeophysical research. Graduates will possess professional, analytical, and personal qualities that will enable them to conduct research effectively, analyze seismic processes, and develop solutions for various industries.

The master's program 7M05304-«Applied Seismology» ensures the development of general scientific, social, informational, and professional competencies in graduates. It fosters personal qualities such as responsibility, a drive for self-development, and the ability to unlock creative potential. It emphasizes the importance of cultivating a culture of thinking, recognizing the social significance of the seismologist's profession, and the ability to make organizational decisions in various situations, while taking responsibility for those decisions.

The master's program 7M05304-«Applied Seismology» provides:

a) Deep knowledge in the field of seismology – understanding the nature of seismic waves, the structure of the Earth's crust and upper mantle, methods for investigating the Earth's crust, earthquake forecasting, seismic hazard assessment, damage from strong earthquakes, deep tectonic processes, and seismicity related to mineral exploration.

b) Skills in working with seismological equipment – installation and maintenance of seismological equipment, placement of seismic stations, working with broadband, short-period, and long-period seismometers, calibration and testing, connection to telemetry systems, data analysis from seismic stations, using portable seismometers, working with accelerometers, registering and recognizing underground nuclear tests using seismic methods.

c) Programming and data analysis – using specialized software to process seismograms and analyze earthquake source mechanisms: SeisComP for earthquake monitoring and automatic processing of seismic records, SAC (Seismic Analysis Code) for waveform analysis and seismogram processing, GMT (Generic Mapping Tools) for visualizing seismological data and creating maps, ObsPy (Python library) for programming and automating seismic data processing, MATLAB and Seismic Unix for signal analysis, filtering, and modeling.

d) Mathematical and physical thinking – working with signal processing algorithms, numerical modeling, and statistical data analysis.

i) Engineering skills – understanding the basics of construction and soil mechanics for assessing seismic hazard to infrastructure objects.

The program includes training in the use of modern computer software for processing seismological data.

For lectures and consultations on current issues in seismology and geophysics, professors from leading universities both near and abroad, as well as top specialists from industrial companies and research institutes, are invited.

Graduates receive the qualification of Master of Engineering and Technology and work at the National Scientific Center of Seismological Observations and Research (NCSSN) of the Ministry of Emergency Situations (MES) of the Republic of Kazakhstan, at the Institute of Geophysical Researches of the National Nuclear Center of the Republic of Kazakhstan (IGI NNC), in regional and city akimats, in the Department of Emergency Situations (DES) and the Commission for Prevention and Liquidation of Emergency Situations (CSE) in engineering positions, or as junior researchers at scientific research institutes.

The content of the master's educational program 7M05304 "Applied Seismology" is based on the principles of multi-level training, fundamental and high-quality education, continuity of science and education, as well as the integration of the learning process with research and innovation activities. The program is focused on maximally meeting the needs of stakeholders and includes the following:

- training highly qualified and competitive specialists in the field of applied seismology, capable of applying advanced methods for assessing seismic hazards, analyzing risks, and forecasting earthquakes.
- developing a deep understanding among students of the methodology, technological processes, and hardware used in seismogeophysical research, as well as mastering methods for processing, interpreting, and modeling seismological data.
- developing the following key competencies in students:

a) applying knowledge from fundamental and technical sciences, including mathematics, physics, and chemistry.

b) acquiring practical skills in working with seismogeophysical instruments and modern software for processing, interpreting, and modeling data using the latest information technologies.

c) effectively using modern methodologies and technical tools necessary for assessing seismic hazards, analyzing risks, and forecasting seismic events.

- forming skills in master’s students:

a) mastery of skills for searching and working with necessary sources of information, including literature, computer data, and databases, to effectively solve the assigned tasks.

b) developing the ability to work in a team while maintaining an individual approach and making independent decisions when necessary.

c) the ability to conduct comprehensive analysis of seismogeophysical data, monitor seismological research, and make management decisions based on the results.

- forming professional and ethical responsibility in master's students, the ability to understand the essence of problems, effectively interact with various specialists, find optimal solutions, and a commitment to continuous development and improvement of their knowledge and skills.
- knowledge of current social and political issues, proficiency in state, Russian, and foreign languages, understanding of market economy principles, as well as the basics of safety and environmental protection.

*Area of Professional Activity**:***

The area of professional activity for master's graduates of the educational program 7M05304-«Applied Seismology» includes: seismic monitoring – observation of seismic activity to prevent earthquakes and reduce their consequences, engineering seismology – assessment of seismic hazards and seismic resistance of buildings, structures, and infrastructure, ecological seismology – study of the impact of man-made and natural processes on the environment, geodynamics and tectonics – study of lithospheric plate movements and forecasting of geodynamic processes, seismic safety – development of measures to protect the population and infrastructure from the consequences of seismic events.

The problem of earthquake forecasting requires the improvement of methods used for forecasting strong earthquakes and a detailed study of the Earth's crust and upper mantle, where most seismic processes occur. The study of the seismic process intersects with physical geography, tectonics, especially neotectonics and seismotectonics, with the mathematical theory of random processes, and with cosmophysics.

Research near seismic sources relies on the achievements of engineering geology and is important for progress in seismic-resistant construction. To study the Earth's internal structure using seismic waves, methods of mathematical physics must be used, as well as combining them with data from gravimetry, geothermics, petrology, geomagnetism, and other Earth sciences.

*Objects of Professional Activity**:***

Seismic waves and their properties; seismic-resistant structures; seismic zoning; seismological research; assessment and forecasting of seismic hazards; ecological and engineering surveys.

Objects of Professional Activity:

- Study of the structure, physical models of the Earth's lithosphere and mantle, and seismic regime.
- Conducting scientific research using seismogeophysical methods, as well as monitoring observation materials.
- Processing, interpreting, and modeling the obtained data, as well as activities aimed at ensuring seismic safety and reducing anthropogenic environmental impact.

Types of Professional Activity:

Graduates of the master's program 7M05304-«Applied seismology» are prepared for scientific-research and scientific-production professional activities. In accordance with their fundamental and professional training, they can perform the following types of activities:

a) organizational and managerial activities:

- planning, organizing, and managing scientific-research and scientific-production field, laboratory, and interpretative seismogeophysical work.
- developing operational plans for the operation of seismic stations.
- selection and justification of scientific, technical, and organizational decisions based on seismogeophysical data and economic calculations.
-planning and organizing scientific and scientific-production seminars and conferences.

b) Scientific-research activities:

- a comprehensive set of field and laboratory studies: placement and operation of seismic stations; conducting geochemical soil sampling in laboratories, geophysical observations for short-term forecasting using GPS stations, monitoring animal behavior at biostations for forecasting purposes.
- development and testing of new technologies: improving equipment for recording seismic signals.
- mastering methods for solving tasks during monitoring and interpretative research using modern seismogeophysical equipment, tools, and information technologies.
- analyzing and systematizing research data, taking into account modern scientific and technological advancements, as well as best domestic and foreign practices in seismology.
- assessing the results of scientific research in seismology, preparing scientific reports, publications, and presentations, as well as filing patents for inventions and discoveries.

c) scientific-production activities:

- independently planning and conducting scientific-research, monitoring, and interpretative work to solve applied problems in seismology.
- collecting, analyzing, and structuring seismological and geological-geophysical data using modern information technologies.
- comprehensive processing, interpretation, and modeling of seismogeophysical data to solve scientific-research tasks in seismology.

d) project activities:

- developing and implementing scientific-technical projects in seismology.
- participating in the expert review of scientific-research projects in the field of seismology.

Spheres of professional activity:

In the specialized field, professional activity may include organizational, technological, and design-calculation work in the following spheres:

- academic and departmental research organizations engaged in solving seismological tasks.
- akimats of regions and cities, as well as departments of emergency situations (DES) and committees for emergency situations (CES).
- organizations involved in environmental monitoring and addressing ecological issues.

2. Goal and Objectives of the Educational Program

Program Goal:

The program is aimed at training specialists who are able to work in scientific, research and production organizations, monitor seismic activity and implement innovative solutions in the field of seismology. Graduates can participate in the creation of seismic zoning maps, the development of measures to reduce seismic

hazard, as well as in the organization and coordination of work taking into account the principles of inclusiveness and sustainable development

Objectives of the Program:

For the specialized direction:

- Acquisition and reinforcement of previously acquired knowledge about deep seismic processes, the structure and properties of the Earth, the tectonic structure of the region, the physical model of the formation of focal zones of strong earthquakes, the processes of their preparation, principles and methods of seismic hazard assessment, practical implementation of seismicity calculation results, and methods of earthquake forecasting.

- Acquisition of skills in processing seismograms and earthquake focal mechanism parameters, modeling seismotectonic deformation of the Earth's crust, analyzing macroseismic materials, and quantitatively assessing seismicity and seismic hazards.

- The mastery of seismic geophysical data processing technologies, the use of specialized software for their analysis and interpretation, as well as conducting engineering and economic calculations of the consequences of earthquakes. This includes assessing demographic and political consequences, calculating the necessary forces and resources for emergency and rescue operations (ER and RRD), seismic risk zoning of cities and settlements, constructing seismic models of typical regions, and performing theoretical calculations of the main seismic impact parameters. It also involves forecasting the degree of destruction according to the MSK-64 scale and assessing the accuracy of the obtained results.

- Development of skills in planning and conducting experiments to study the Earth's deep structure using seismic methods, processing and interpreting the obtained data. This includes performing instrumental seismic observations, including in the epicentral zones of strong earthquakes, determining the parameters of earthquake foci from seismic records and macroseismic manifestations. It also involves conducting general, detailed, and microseismic zoning work, as well as preparing conclusions on seismic hazards for specific territories and objects.

- Mastery of skills in installing, configuring, and maintaining seismic recording equipment, analyzing and interpreting seismic records, and identifying seismic events. This includes assessing the location of the earthquake focus and its magnitude based on seismic waves, determining the intensity of ground shaking (on a scale) from macroseismic manifestations, as well as creating and analyzing seismic zoning maps.

- Implementation of knowledge and skills in the field of environmental responsibility, social sustainability and effective project management;

- Development of practical skills and competencies for the implementation of engineering solutions that contribute to the achievement of the SDGs.

3. Requirements for assessment of learning outcomes of the educational program

As a result of mastering the master's program, the graduate should possess deep theoretical knowledge and practical skills necessary for conducting fundamental research related to the causes, processes of preparation, and occurrence of earthquakes, as well as their consequences. The main areas of seismology include the study of processes occurring at the earthquake focus, analysis of the seismic wave field both near and far from the epicenter, seismic hazard assessment and zoning, as well as earthquake forecasting.

The study of the seismic process involves examining the totality of earthquakes in space and time, identifying causal and stochastic patterns of their occurrence, and their connection to the overall evolution of the Earth.

The graduate of the Department of «Geophysics and Seismology» in the master's program should know: the goals and objectives of applied seismology within the system of Earth sciences; recognize the social significance of their future profession, possess high motivation for professional activity; be able to assess the capabilities of each seismic method and navigate the applicability conditions of specific methods; possess skills in working with seismogeophysical equipment, methods for processing and interpreting monitoring data, including with computer software as a tool for information management.

Graduates of the 7M05304-«Applied Seismology» master's program should: be aware of modern trends in the development of the seismological field; its current methodological and philosophical issues; the current state of the economic, political, legal, cultural, and technological environment in global business partnerships.

Graduates of the 7M05304-«Applied Seismology» Master's Program should possess the ability to:

- engage in abstract thinking, analysis, and synthesis of seismological database; be ready to act in non-standard situations, take social and ethical responsibility for decisions made, demonstrate a desire for self-development, self-realization, and use of creative potential.
- independently acquire, understand, structure, and apply new knowledge and skills in professional activity, developing their innovative abilities.
- be able to independently formulate research goals and establish a logical sequence for solving professional tasks; apply the knowledge of fundamental and applied disciplines that define the direction (profile) of the master's program.
- possess professional competencies (PC) corresponding to the type of professional activity that the master's program is oriented towards.

Graduates of the 7M05304-«Applied Seismology» master's program should be capable of:

- formulating diagnostic solutions to seismological problems by integrating fundamental sections of seismological sciences and specialized knowledge;
- independently conducting scientific and methodological work and research in seismology, summarizing and analyzing experimental information, drawing conclusions, formulating recommendations;
- conducting independent scientific research and monitoring work; being proficient in the use of modern equipment and instruments.

Graduates of the 7M05304-«Applied Seismology» master's program should:

- be able to use effective methods of processing and interpreting complex information to solve tasks; create and investigate models of studied objects based on advanced theoretical and practical knowledge.
- have communication skills to present their proposals and recommendations in oral and written forms.
- be able to use effective methods of processing and interpreting complex information to solve production tasks; build and study models of objects based on deep theoretical and practical knowledge.
- critically analyze, present, defend, discuss, and disseminate the results of their professional activities.
- possess skills in preparing and drafting scientific and technical documentation, research reports, reviews, presentations, and articles.
- be competent in searching for and interpreting technical information using various search systems (patent search, literature reviews of journals and books, the internet), in selecting and creatively using modern equipment to solve scientific and practical problems of applied seismology.
- be socially mobile, able to adapt to new situations in a professional environment.
- be able to perceive diversity and intercultural differences, value diverse approaches to understanding and solving societal problems.
- be able to organize cooperation in a team, demonstrate creativity and a broad range of interests to solve interdisciplinary problems.
- to perceive social, ethnic, religious and cultural differences in a tolerant manner, to appreciate the traditions of other cultures, their diversity in modern society, fundamental basic education, economic, social and legal training;
- be capable of self-criticism and criticism, possess collaboration and interaction skills, and be ready to assume the role of a team leader.
- be ready for communication in oral and written forms in Kazakh, Russian, and foreign languages to solve professional tasks.
- maintain the rules of ethics in society, at work and in interpersonal communication, demonstrate the ability to achieve goals, solve problems in non-standard situations.
- to take care of environmental protection and, by improving skills, to serve the development of the welfare of the whole society.

4. Passport of the Educational Program

4.1. General Information

№	Field Name	Note
1	Code and Classification of the Field of Education	7M05 «Natural Sciences, Mathematics, and Statistics»
2	Code and Classification of Training Directions	7M053 «Physical and Chemical Sciences»
3	Group of Educational Programs	M091 «Seismology»
4	Name of the Educational Program	7M05304-«Applied Seismology»

5	Short description of the educational program	The Master's program in 7M05304-«Applied Seismology» provides: a) In-depth knowledge in the field of seismology – understanding the nature of seismic waves, the structure of the Earth's crust and upper mantle, methods for studying the Earth's crust, earthquake prediction, seismic hazard assessment, the damage caused by strong earthquakes, deep tectonic processes, and seismicity related to the exploration of natural resources. b) Skills in working with seismological equipment – installation and maintenance of seismological instruments, placement of seismic stations, working with broadband, short-period, and long-period seismometers, calibration and testing, connection to telemetry systems, data analysis from seismic stations, use of portable seismometers, working with accelerometers, and the registration and recognition of underground nuclear tests using seismic methods. c) Programming and data analysis – using specialized software to process seismograms and analyze the data from earthquake focal mechanisms: SeisComP for earthquake monitoring and automatic seismic record processing, SAC (Seismic Analysis Code) for waveform analysis and seismogram processing, GMT (Generic Mapping Tools) for visualizing seismic data and constructing maps, ObsPy (Python library) for programming and automating seismic data processing, MATLAB and Seismic Unix for signal analysis, filtering, and model construction. d) Mathematical and physical thinking – working with signal processing algorithms, numerical modeling, and statistical data analysis. e) Engineering skills – understanding the basics of construction and soil mechanics to assess seismic hazards for infrastructure objects.
6	Goal of the Educational Program	The program is aimed at training specialists who are able to work in scientific, research and production organizations, monitor seismic activity and implement innovative solutions in the field of seismology. Graduates can participate in the creation of seismic zoning maps, the development of measures to reduce seismic hazard, as well as in the organization and coordination of work taking into account the principles of inclusiveness and sustainable development

7	**Type of Educational Program:**	New EP
8	Level according to NQF:	7
9	Level according to EQF	7
10	Distinctive Features of the Program	no
11	Basic Knowledge, Skills, and Competencies (B)	B1 - The ability to independently acquire, comprehend, structure, and apply new knowledge and skills in professional activities, and to develop innovative capabilities. B2 - The ability to apply fundamental and applied knowledge of seismogeophysical disciplines in practice, determining the focus (profile) of the master's program in seismology. B3 - The ability to independently design and conduct research activities in the field of seismology using modern research methods, information and communication technologies, and based on integrated geophysical and interdisciplinary studies. B4 - The ability to professionally select and creatively use modern scientific and technical equipment to solve scientific and practical problems in seismology. B5 - An understanding of the nature and significance of the relationship between theoretical and practical research in seismology, enabling effective and rational study of seismic processes and mechanisms; reducing the risks of technological impacts on industrial and civil structures. B6 - The ability to solve complex problems in seismology using innovative technologies. B7 - Knowledge of the goals and objectives of fundamental and applied geophysical research in the field, basic principles and methods of their organization, and the primary sources of information and the requirements for presenting information materials. B8 - Proficiency in preparing and formatting scientific and technical documentation, research reports, reviews, presentations, and articles on seismology topics. B9 - The ability to critically analyze, present, defend, discuss, and disseminate the results of professional activities. B10 - Willingness to use modern scientific communication methods and technologies in both the national and foreign languages to address current seismology challenges.

		Professional competencies (PC): PC1 - The ability to form diagnostic solutions to professional seismological problems by integrating fundamental and applied sections of geophysics (including gravimetry, magnetotellurics, seismology, and seismic exploration) and specialized geological and geophysical knowledge (including physical processes occurring in the Earth and the Earth's internal structure) to solve seismology problems. PC2 - Knowledge of the promising areas of development and issues in seismology, as well as the current level of progress in addressing these issues. PC3 - The ability to independently formulate research goals, establish the sequence for solving professional seismological problems using modern equipment, software, and information technologies, and by applying the latest domestic and international experience. PC4 - The ability to independently conduct scientific experiments and research in seismology, generalize and analyze experimental data, make conclusions, formulate findings, and offer recommendations. PC5 - The ability to freely and creatively use modern methods of processing and interpreting seismological information to solve scientific and practical problems, including those in related areas of knowledge. PC6 - The ability to create and investigate models of studied objects based on in-depth theoretical and practical knowledge in seismology. PC7 - The ability to independently develop and present research project proposals, prepare and coordinate technical assignments for developing project solutions. PC8 - Proficiency in the professional operation of modern seismological equipment and instruments. PC9 - The ability to identify and systematize key ideas in scientific publications; critically evaluate the effectiveness of various approaches to solving seismological tasks; formulate an independent viewpoint on the proposed problem, taking into account the latest domestic and international experience. PC10 - The ability to manage scientific and industrial works in solving complex seismology problems at the stages of design, execution (including processing, analysis, and interpretation), report preparation, and presentation of results. PC11 - Proficiency in using software packages for working with a complex of geological-geophysical data. PC12 - Proficiency in the basic methods of collecting, analyzing, storing, and processing scientific and technical information. PC13 - The ability to conduct seminars, laboratory, and practical classes (within domestic and international educational programs) in geophysics (according to specialization) using modern educational technologies.

		Humanistic, socio-ethical competencies (H): H1 – Understanding and practical application of healthy lifestyle norms, including issues of prevention and the use of physical culture to enhance work performance. H2 – Proficiency in the state language, Russian, and one of the widely spoken foreign languages at a level sufficient for human communication. H3 – Awareness of the need to acquire the ability to independently learn and improve qualifications throughout one's career. H4 – Readiness for self-development, self-realization, and the use of creative potential. H5 – Ability to plan and solve tasks for personal and professional development. H6 – Willingness to act in non-standard situations, to bear social and ethical responsibility for decisions made. H7 – Ability for abstract thinking, analysis, and synthesis. H8 – Ability to use systemic logical thinking when analyzing scientific data and setting practical tasks for seismological research. **Specialized and managerial competencies (S):** S1 – Independent management and control of work processes within the strategy, policies, and goals of an organization, discussing issues, arguing conclusions, and effectively handling information. S2 – Readiness to lead a team in the field of professional activity while tolerantly perceiving social, ethnic, confessional, and cultural differences. S3 – Knowledge and mastery of key managerial functions (decision-making, organization, motivation, control) and methods of their implementation. S4 – Possession of organizational skills, the ability to create mobile work groups to achieve set goals, manage such a group, defend their rights, and demand that they fulfill their duties. S5 – Proficiency in interpersonal communication methods, public speaking skills.
12	Learning outcomes of the educational program:	LO1**:** To demonstrate theoretical and practical knowledge in the field of fundamental concepts of physics, geophysics, geodynamics, as well as modern digital technologies and artificial intelligence methods for analyzing and solving professional problems of applied seismology LO2**:** Apply organizational and project management tools, as well as communication skills for effective interaction in a professional environment, including in intercultural communication in foreign languages, taking into account inclusivity and sustainable development LO3: Apply system knowledge and practical skills for the organization and conduct of stationery and field seismological observations, including the collection of a priori information, equipment preparation and digital data processing using modern information systems

		LO4: Analyze the quality of the materials obtained to create digital databases based on information technologies for forecasting spatial and temporal processes based on geological and geophysical data LO5: To synthesize complex geological and geophysical data for solving seismological and geodynamic problems in earthquake focal zones based on the development of seismic and integrated geophysical models LO6: Critically evaluate contemporary national and international scientific research in the field of seismology, form a well-reasoned independent opinion, and professionally present and defend personal results while demonstrating respect for scientific and professional partners LO7**:** Synthesize mathematical, informational, geological, and geophysical knowledge to develop comprehensive, sustainable, and innovative solutions to seismological problems
13	Form of Education	Full-time
14	Duration of Study	1 year
15	Number of Credits**:**	60
16	Languages of Instruction**:**	Kazakh/Russian
17	Awarded Academic Degree	Master of Engineering and Technology
18	Developers and Authors**:**	Professor A.E. Abetov, Associate Professor G.K. Umirova, Senior Teacher A.O. Siylkanova, Teacher S.K. Dossaibekova, Teacher B.A. Baltabayeva

4.2. Interrelation between the Achievability of Learning Outcomes in the Educational Program and the Academic Disciplines

№	Course Title	Brief Description of the Course	Number of Credits	Learning Outcomes Formed (Codes)						
				LO1	LO2	LO3	LO4	LO5	LO6	LO7
M-1. Basic Training Module (University Component)										
1	Foreign Language (Professional)	The purpose of the discipline is to acquire and improve competencies in accordance with trade standards of foreign education, capable of competing in the labor market, because through a foreign language, the future master gains access to academic knowledge, new technologies and modern information, allowing the use of a foreign language as a means of communication in the intercultural, professional and scientific activities of the future master.	2		V				V	
2	Management	To form a scientific understanding of management as a type of professional activity. Contents: Mastering the general theoretical principles of managing socio-economic systems; acquiring skills and abilities in practical problem-solving of managerial issues; studying global management practices and the specificities of Kazakhstani management; training in solving practical issues related to managing various aspects of organizational activities.	2		V				V	
3	Psychology of Management	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.	2		V				V	
M-1. Basic Training Module (Elective Component)										

4	Geophysical Methods in the Study of Geodynamic Processes	Objective: To develop knowledge and skills in using geophysical methods to analyze geodynamic processes, assess tectonic activity, and identify structural features of the lithosphere. Contents: Possibilities and limitations of geophysical methods in the study of the deep structure of the Earth. Assessment of tectonic structures by seismic exploration. Features of interpretation of gravimagnetic data in the study of geodynamic processes. Mapping of active faults and tectonic blocks using geoelectric methods. Assessment of natural risks using geophysical data. Reconstructions of processes in the lithosphere based on complex geophysical data based on digital technologies	4	V				**V**		V
5	Structure and Properties of the Lithosphere	Objective: To form knowledge about the lithosphere as a key component of the Earth's shell, its structure, physical and chemical properties, and to analyze data on the structure and properties of the lithosphere to solve geological and geophysical problems. Content: Structure of the lithosphere. Properties of the lithosphere. Tectonic processes and movement of lithospheric plates. Methods of lithosphere research, the role of the lithosphere in global processes. Earthquakes and volcanism as processes within the lithosphere. Forecasting and risk assessment of natural disasters.	4	V				V		V
CYCLE OF CORE DISCIPLINES (CD)										
M-2. Specialized training module (university component or elective component)										
6	Practical Aspects of Seismic Event Monitoring	Purpose: To gain knowledge and skills on the use of modern equipment, principles of registration of seismic events, methods of their processing, interpretation and modeling to solve the problems of seismological monitoring. Contents: Methods of monitoring seismic activity. Technique and technology of modern registration of seismic events. Processing and analysis of seismic observation data for monitoring seismic events. Global and regional seismic monitoring networks, automated systems and technologies in seismic monitoring. Monitoring of man-made seismic events	5	V		V	V			

7	Processes and Mechanisms of Earthquake Formation	Objective: To develop knowledge and skills in the field of studying the mechanisms of earthquake formation using modern modeling methods to assess seismic hazards Contents: Physical and geomechanical foundations of earthquake foci formation. Mechanisms of faulting and stress accumulation in the lithosphere. Parameterization of earthquake foci, their typification and role in the seismic cycle. Methods of laboratory and numerical modeling of deformation processes. Forecast of seismic impact parameters. Assessment of seismic hazard. Development of sustainable engineering and seismological solutions	5	V				V		V
8	Modern Technologies for Seismological Data Processing	Objective: To familiarize graduate students with modern tools and technologies for processing seismological data. To conduct analyses of seismic events. To apply automated and intelligent systems for processing large datasets. Content: Processing of seismological data, methods of registering and storing seismological data. Preliminary processing of seismic data. Processing of seismic wave signals, localization and characterization of seismic events. Automated data processing methods, modern tools and software.	5	V		V	V			V
9	Software methods in seismological data analysis	Objective: To teach graduate students the basic approaches, tools, and software methods used for processing, analyzing, and interpreting seismic data. Content: Automation of data processing, visualization of seismic data. Use of software for calculating earthquake focal mechanisms. Working with earthquake catalogs, basics of working with seismic data. Theoretical knowledge of seismic phenomena along with practical skills in working with professional programs and programming languages.	5	V		V	V			V
10	Seismic Forecasting	Objective: To acquire knowledge of seismic forecasting methods and to develop data analysis skills for building predictive models in order to assess seismic hazards. Contents: Seismic activity and patterns of earthquake distribution. Methods of short-term earthquake forecasting. Methods of medium- and long-term forecasting. Forecasting based on statistical methods. Assessment of seismic risk and danger, instrumental methods of monitoring and forecasting. The use of digital technologies in earthquake forecasting	5	V			V	V		V

11	Seismology of Engineering Structures	Objective: To develop knowledge and skills for analyzing seismic impacts on engineering structures, assessing their earthquake resistance, and applying seismological data in engineering calculations. Content: The interaction of seismic waves with structures of buildings and structures. Calculation of the seismic load. Assessment of seismic risk and vulnerability of facilities. Methods of engineering and seismological surveys. Registration of seismic impacts on structures. Interpretation of monitoring data, regulatory framework for the design of earthquake-resistant facilities. Analysis of seismograms, modeling of structural dynamics and application of digital software complexes	5	V		V		V		V
12	Assessment of seismic hazard and damage	Objective: To gain knowledge on methods for assessing seismic hazards, analyzing and predicting earthquake damage in order to develop recommendations for reducing hazards and damage Contents: Seismic zoning. Geophysical and geological factors of seismic hazard. Probabilistic models of seismic hazard assessment (PSHA). Methods for assessing seismic risk and damage. Digital software systems for seismic hazard and risk assessment. Experimental methods of seismic hazard assessment. Damage assessment for various types of structures	5	V			V	V		V
13	Assessment of Seismic Hazard and Risk for Construction	Objective: To develop an understanding of the physical nature of seismic processes and their impact on building structures, and to use modern methods of analysis, modeling, and forecasting seismic effects. Content: Seismic hazard and risk, physical foundations of seismic phenomena. Methods for assessing seismic hazards, seismic zoning. Geological and soil conditions, the impact of seismic effects on structures. Seismic modeling and forecasting, seismic risk assessment. Earthquake-resistant design, monitoring, and seismic risk mitigation.	5	V			V	V		V

14	Instrumental and Methodological Basis of Seismic Observations	Objective: To develop knowledge about the construction and functioning of seismic monitoring systems, as well as methods for collecting, processing and interpreting seismic data within the framework of local and regional observation networks. Contents: Architecture of seismic observation systems. The principles of station placement, telemetry, synchronization, data transmission, and the structure of monitoring centers. Organization of seismic observations: selection of sensitivity and frequency range of equipment, data quality assurance, algorithms for processing seismograms, integration of data into national and international systems. Modeling of observation networks	4	V		V	V			
15	Seismological Equipment	Objective: To form knowledge about the device and principles of operation, the use of modern seismological equipment for recording and analyzing seismic data Contents: The main types of seismological devices, principles of operation of seismological devices. Components of seismological equipment, digital recording systems. Field seismological devices, stationary seismological stations. Methods of calibration and adjustment of instruments, modern developments in seismology. Equipment for monitoring strong earthquakes, features of operation of seismological devices in real conditions	4	V		V	V			V

5. Curriculum of the 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 20.02.2025 Minutes № 9

WORKING CURRICULUM

Academic year	**2025-2026 (Autumn, Spring)**
Group of educational programs	**M091 - "Seismology"**
Educational program	**7M05304 - "Applied Seismology"**
The awarded academic degree	**Master of engineering and technology**
Form and duration of study	**full time (professional track) - 1 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		
									1 sem	2 sem	
CYCLE OF GENERAL EDUCATION DISCIPLINES (GED)											
CYCLE OF BASIC DISCIPLINES (BD)											
M-1. Module of basic training (university component)											
LNG212	Foreign language (professional)		BD, UC	2	60	0/0/30	30	E	2		
MNG726	Management		BD, UC	2	60	15/0/15	30	E	2		
HUM211	Psychology of management		BD, UC	2	60	15/0/15	30	E	2		
M-1.1 Component of choice											
GIS201	Geophysical methods in the study of geodynamic processes	1	BD, CCH	4	120	30/0/15	75	E	4		
GIS202	Structure and properties of the lithosphere	1	BD, CCH	4	120	30/0/15	75	E	4		
CYCLE OF PROFILE DISCIPLINES (PD)											
M-2. Module of professional activity (component of choice)											
GIS205	Practical aspects of monitoring seismic events	1	PD, CCH	5	150	30/0/15	105	E	5		
GIS206	Processes and mechanisms of earthquake formation	1	PD, CCH	5	150	30/0/15	105	E	5		
GIS207	Modern technologies for processing seismological data	2	PD, CCH	5	150	30/0/15	105	E	5		
GIS208	Software methods in seismological data analysis	2	PD, CCH	5	150	30/0/15	105	E	5		
GIS209	Seismic forecasting	3	PD, CCH	5	150	30/0/15	105	E	5		
GIS210	Seismology of engineering structures	3	PD, CCH	5	150	30/0/15	105	E	5		
GIS211	Assessment of seismic hazard and damage	4	PD, CCH	5	150	30/0/15	105	E	5		
GIS212	Assessment of seismic hazard and risk for construction	4	PD, CCH	5	150	30/0/15	105	E	5		
GIS213	Instrumental and methodological base of seismic observations	1	PD, CCH	4	120	30/0/15	75	E		4	
GIS214	Seismological equipment	1	PD, CCH	4	120	30/0/15	75	E		4	
M-3. Practice-oriented module											
AAP253	Internship		PD, UC	5				R		5	
M-4. Experimental and research module											
AAP257	Experimental research work of a master student, including an internship and the implementation of a master's project		ERWMS	13				R		13	
M-5. Module of final attestation											
ECA213	Design and defense of the master's project		FA	8						8	
Total based on UNIVERSITY:									30	30	
									60		

Number of credits for the entire period of study

		Credits

Cycle code	Cycles of disciplines	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	6	4	10
PD	Cycle of profile disciplines	0	5	24	29
Total for theoretical training:		**0**	**11**	**28**	**39**
RWMS	Research Work of Master's Student				0
ERWMS	Experimental Research Work of Master's Student				13
FA	Final attestation				8
TOTAL:					**60**

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 № 5 dated 28.01.2025

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 - Geology and Oil-gas Business Institute named after K. Turyssov — Auyelkhan Y. .

Department Chair - Geophysics and seismology — Ratov B. T.

Representative of the Academic Committee from Employers ____Acknowledged____ — Mikhailova N. N.