SATBAYEV UNIVERSITY

Institute of Geology and Oil and Gas Business named after K.Turysov

Department of Geophysics

EDUCATIONAL PROGRAM

7M05302 - Seismology

The code and the name of the educational program

The code and the classification of the area of education: 7M05 -Natural sciences, mathematics and statistics
The code and the classification of areas of study: 7M053-Physical and chemical sciences
Group of educational programs: D091 - Seismology
NQF Level: 7
IQF Level: 7
Training period: 2 years
Volume of credits: 120

Almaty 2022

Submitted and recommended for approval at a meeting of the Educational and Methodological Council of KazNRTU named after. K.I. Satpaeva.

Minutes No. 4 dated January 14, 2020

The educational program 7M05302 - Seismology was developed by the academic committee in the direction 7M053 - Physical and chemical sciences

Full name	Academic degree/ academic title	Job title	Work place	Signature
Chairman of the Academic Committee:				
Iskakov R.M.	Professor, PhD	Vice-Rector for Academic Work	JSC KazNRTU named after K.I.Satpayev	
Faculty members:				
Abetov A.E.	Candidate of Sciences in Geology and Mineralogy, Professor	Head of the Department of "Geophysics"	JSC KazNRTU named after K.I.Satpayev	
Umirova G.K.	Doctor Ph.D	Assoc.Professor	JSC KazNRTU named after K.I.Satpayev	
Providers of works				
Uzbekov N.B.	Candidate of Sciences in Geology and Mineralogy	Deputy Director	Institute of Seismology	
Mikhailova N.N.	Doctor of Physics and Mathematics Sciences	Deputy Director	Institute of Geophysical Research	
Sokolova I.N.	Doctor of Physics and Mathematics Sciences	Leading Researcher	Institute of Geophysical Research	
From partner universities:				
Kopnichev Yu.F	Doctor of Physics and Mathematics Sciences	Chief Researcher	Institute of Physics of the Earth RAS; Laboratory "Origin, internal structure and dynamics of the Earth and planets"	
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Isagalieva A.K.	Master of Engineering and Technology	Lecturer of the Department of Geophysics	JSC Kazntu named after K.I.Satpayev	
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List of abbreviations and designations

B – basic knowledge, skills and abilities;
SMSE – state mandatory standards of education;
ICT – information and communication technologies;
KazNRTU – Kazakh National Research Technical University;
MES RK – Ministry of Education and Science of the Republic of Kazakhstan;
NRK – National Qualifications Framework;
U – universal, social and ethical competencies;
OQF – Industry Qualifications Framework;
PC – professional competencies;
RAS RF– Republican Academy of Sciences of the Russian Federation;
LO – learning outcomes of the educational program;
S – special and managerial competencies;

1. Description of the educational program

The educational program of the master's degree in the field of training "Seismology" stimulates the formation of in-depth fundamental knowledge among graduates; abstract thinking and originality of analysis that go beyond the issues covered by standards and practice; forms the ability to make non-standard decisions in problem situations; adaptation to new situations, reassessment of accumulated experience, creation of new knowledge based on seismogeophysical research; setting innovative professional tasks in the field of research and practical activities; search for optimal solutions to professional tasks, taking into account their validity, cost, information, social and economic security; solving managerial tasks in the conditions of actual production structures.

The educational program of the master's degree in the field of training "Seismology" ensures the formation of general cultural, general scientific, social, informational, professional and pedagogical competencies among graduates; the development of such personal qualities as responsibility, the desire for self-development and the disclosure of their creative potential, possession of a culture of thinking, awareness of the social significance of the profession of a seismologist, the ability to make organizational decisions in different situations and willingness to take responsibility for them.

The Master's program in the direction of "Seismology" provides:

a) training of highly qualified specialists in the field of seismogeophysical methods of seismic hazard assessment, earthquake risk and prediction;

b) they receive high-quality and professional knowledge on forecasting the places of occurrence, strength and recurrence of earthquakes; conducting detailed studies of earthquake preparation processes in a real physical and geological environment, displacements of Earth blocks and other transformations of the environment in foci, assessing the parameters of the focus, identifying earthquake precursors and those who are able to develop long-term, medium-term and short-term earthquake forecasts, ways to control the seismic process, assess the possibility of anthropogenic (man-made) influence on seismicity;

c) professional solution of engineering and seismological problems in the study of earthquake-induced seismic wave field near the hearth, the study of strong seismic movements of the Earth's surface and the interaction of soil with the structure, the development of methods and conducting seismic micro-zoning, determining the impact of earthquakes on the hydrosphere and the Earth's atmosphere.

d) qualified research away from the earthquake source when studying the wave seismic field at distances exceeding the length of the seismic wave, as well as the development and use of seismic methods of cognition of the internal structure of the Earth. Adjacent to this direction is the study of seismic noise on the Earth's surface - microseism. The applied tasks include registration and recognition of underground nuclear tests by seismic methods.

e) obtaining high-quality and professional knowledge by undergraduates on the stages and rational complex of seismological research, processing, interpretation and modeling of the data obtained.

The program includes training in modern computer programs for processing seismological data.

Professors from leading universities near and far abroad, leading experts from manufacturing companies and research institutes are invited to conduct lectures and consultations on modern problems of seismology and geophysics.

Graduates receive a Master's degree in Seismology and work at the Institute of Seismology and SOM of the Ministry of Education and Science of the Republic of Kazakhstan, in the IGI of the National Research Center of the Republic of Kazakhstan, in akimats of regions, cities, in emergency situations and emergency situations in engineering positions, in research institutes as researchers.

The content of the Master's degree program in the direction of "Seismology" on the basis of the development of a multi-level system of personnel training, the fundamentals and quality of

training, continuity and continuity of education and science, unity of training, education, research and innovation activities aimed at maximum satisfaction of consumer needs should ensure:

- training of professional and competitive highly qualified specialists in the field of seismology, capable of applying innovative methods in assessing seismic hazard, risk and earthquake forecasting;
- preparation of masters who know the methodological basis, equipment, technology and methods of conducting seismogeophysical work, methods of processing, interpretation and modeling of the obtained seismological data;
- development of masters' abilities: a) apply knowledge of fundamental and technical sciences, including mathematics, physics, chemistry; b) to acquire practical skills of working with seismic and geophysical equipment, modern software for processing, interpretation and modeling of obtained seismological data using modern information technologies; c) use the methods, skills and modern technical means necessary for assessing seismic hazard, risk and earthquake forecasting;
- formation of masters: a) the ability to find and work with the necessary literature, computer information, databases and other sources of information to solve the tasks; b) teamwork skills, but at the same time to show individuality, and if necessary to solve problems independently; c) to conduct a comprehensive analysis of seismogeophysical data and monitoring of seismological work, as well as to make management decisions based on their results;
- formation of masters of industrial and ethical responsibility, the ability to understand the problem, the ability to work together with various specialists, to find optimal solutions, the need to improve their knowledge and skills;
- knowledge of modern social and political problems, proficiency in state, Russian and foreign languages, market economy tools, safety and environmental issues.

Field of professional activity:

The field of professional activity of masters in the field of Seismology includes: the study of the structure and material composition of the lithosphere and tectonosphere of the Earth, the study of foci and precursors of earthquakes based on the achievements of solid state physics, mechanics, especially the theory of brittle fracture of materials, geodesy, various sections of Earth physics, hydrogeology, geochemistry.

The problem of earthquake prediction is close to the problem of predicting mountain impacts, which are studied by mining sciences. The study of the seismic process is in contact with physical geography, tectonics, especially with neotectonics and seismotectonics, with the mathematical theory of random processes, with cosmophysics.

Studies near the hearth take into account the achievements of engineering geology and are necessary for the development of earthquake-resistant construction. The use of seismic waves to study the internal structure of the Earth requires the use of methods of mathematical physics and combination with data from gravimetry, geothermy, petrology, geomagnetism and other Earth sciences.

Objects of professional activity:

Lithosphere and mantle of the Earth; geophysical fields; natural and man-made geological processes; computerized and software-controlled information-measuring and processing systems and complexes.

Subjects of professional activity:

- Study of the structure, physical models of the Earth's lithosphere and mantle, seismic regime;
- Conducting scientific research using seismogeophysical methods, as well as materials of monitoring observations;
- Processing, interpretation and modeling of the received data, as well as measures to ensure seismic safety and reduce the anthropogenic load on the environment.

Types of professional activity:

Masters in the field of training "Seismology" are preparing for research and scientific and industrial professional activities. In accordance with the fundamental and professional training they have received, they can perform the following activities:

а) organizational and managerial activities:

- planning, organization and management of research and scientific-production field, laboratory and interpretive seismogeophysical works;
- development of operational work plans for seismological stations;
- selection and justification of scientific, technical and organizational solutions based on seismogeophysical data and economic calculations;
- planning and organization of scientific and production seminars and conferences.

б) research activities**:**

- independent selection and justification of the goals and objectives of scientific seismological research;
- mastering the methods of solving the tasks set during monitoring, interpretation studies using modern seismogeophysical equipment, instruments and information technologies;
- analysis and generalization of research results using modern achievements of science and technology, advanced domestic and foreign experience in the field of seismology;
- evaluation of the results of scientific research seismological work, preparation of scientific reports, publications, reports, preparation of applications for inventions and discoveries.

в) scientific and production activitiesность:

- independent preparation and conduct of research, monitoring and interpretation studies in solving practical problems in the field of seismology;
- collection, analysis and systematization of available seismological and geological-geophysical information using modern information technologies;
- complex processing, interpretation and modeling of seismogeophysical information in order to solve research problems in the field of seismology;
- participation in the development of normative methodological documents in the field of seismological research.

г) project activities**:**

- design and implementation of scientific and technical projects in the field of seismology;
- participation in the examination of projects of scientific research seismological works.

д) scientific and pedagogical activity:

- participation in the preparation and conduct of seminars, laboratory and practical classes;
- participation in the management of the research work of undergraduates.

Areas of professional activity:

With the profile direction: organizational and technological; settlement and design activities in:

- academic and departmental research organizations related to the solution of seismological problems;
- in akimats of regions, cities, in departments of emergency and emergency situations;
- organizations related to environmental monitoring and solving environmental problems.

At the scientific and pedagogical direction:

Organizational and managerial; research; educational (pedagogical) activities of various directions in higher educational institutions, scientific activities in information services of research institutions, public administration bodies, educational institutions, design organizations, industrial enterprises.

2. The purpose and objectives of the educational program

EP goals:

Training of highly qualified specialists of seismologists of international level, capable on the basis of innovative methods and technologies of seismogeophysical research and with the use of

advanced hardware and methodological and modern software for conducting research and professional activities:

- organize and carry out registration, processing and complex analysis of seismological data, solve complex tasks on long-term, medium-term and short-term algorithms for forecasting natural and man-made earthquakes;
- to build maps and sections characterizing regional and local seismicity, to identify seismogenerating zones in areas of anthropogenic activity, to identify the consequences of strong natural and man-made earthquakes;
- to apply methods and techniques of seismotectonic and paleoseismogeological studies, to assess seismic hazard, to conduct regional and detailed seismic zoning, and micro-zoning; to perform engineering analysis of the consequences of earthquakes and methods of earthquake protection using methods to ensure the seismic safety of the population and territories with special seismic protection systems.
- perform mathematical analysis of seismic fields and carry out statistical calculations of seismic regime parameters, build earthquake preparation models, identify preparation stages and earthquake precursors, classify their types.

EP tasks:

With the profile direction:

- Acquisition and consolidation of previously acquired knowledge about the fundamental laws of radiation and propagation of seismic waves in the Earth, theories and methods of studying its internal structure with the help of seismic waves, modern ideas about the nature and basic laws of seismicity of the Earth as a whole and the seismic regime of various fields, modern models of earthquake physics and processes of its preparation, principles and methods of assessment seismic hazard, seismic zoning and earthquake prediction.
- Acquisition of skills in processing, interpretation and modeling of geological and geophysical data, construction of geodynamic and geostatic models of the lithosphere; tectonic zoning of the foundation of platforms and orogenic areas; prediction of the internal structure of deformation-stressed zones.
- Acquisition of experience in the use of technologies for processing seismogeophysical data, skills in working with specialized systems for processing and interpreting these data, the use of engineering and economic calculations of the consequences of earthquakes; demographic and political consequences of them, the necessary forces and means for emergency rescue and other urgent work (AS and DNR), i.e. emergency response; zoning of the seismic risk of cities and settlements, building seismic models for the most typical regions, carrying out theoretical calculations of the main parameters of seismic impacts for them, predicting the degree of destruction on the MSK-64 scale. evaluate the reliability and accuracy of the results obtained.
- Acquisition of the ability to plan experiments to study the deep structure of the Earth by seismic methods, process and interpret the data obtained, conduct instrumental seismic observations, including in the epicentral zone of strong earthquakes, determine the parameters of earthquake foci from seismic records and macroseismic manifestations, plan and carry out work on general, detailed and microseismic zoning, draw conclusions about seismic hazard specific territories and objects.
- mastering the skills of installation and maintenance of seismic recording equipment, analysis and interpretation of seismic records, isolation of seismic events, assessment of the location of the focus and determination of earthquake magnitude by seismic waves, intensity of concussions (score) by macroseismic manifestations of an earthquake, compilation and analysis of seismic zoning maps.

At the scientific and pedagogical direction:

- in-depth theoretical and practical training in seismogeophysics, as well as pedagogical activity;
- training of competitive specialists with a high level of professional culture, in demand in

the labor market and possessing a set of necessary knowledge and skills, able to formulate and solve modern scientific and practical problems of seismology, teach at universities, successfully carry out research and management activities;

- acquisition of skills in organizing and conducting seismological research, obtaining the necessary foundation for continuing scientific work in doctoral studies;
- obtaining knowledge in the field of university pedagogy, psychology and teaching experience at the university.

3. Requirements for evaluating the learning outcomes of an educational program

As a result of mastering the master's degree program, the graduate should have deep theoretical knowledge and practical skills in the field of fundamental research of the causes, processes of preparation and occurrence of earthquakes, as well as the consequences associated with them. The main seismological directions include the study of processes in the earthquake focus, the wave seismic field near and far from its focus, the assessment and zoning of seismic hazard, the forecast of strong earthquakes.

The study of the seismic process includes the study of the totality of earthquakes in space and time, the identification of causal and stochastic patterns of their occurrence and connection with the general evolution of the Earth.

A graduate of the Department of Geophysics under the Master's degree program should know: the goals and objectives of seismology in the system of Earth sciences; be aware of the social significance of their future profession, have high motivation to perform professional activities; be able to assess the capabilities of each seismological method and navigate the applicability of individual methods; possess skills in working with seismogeophysical equipment, methods of processing and interpretation of monitoring data. data, including software on a computer, as a means of information management.

A graduate of the Master's degree in Seismology should: have an idea of current trends in the development of the seismological industry; about its current methodological and philosophical problems; about the current state of the economic, political, legal, cultural and technological environment of the global business partnership.

Graduates of the Master's degree program "Seismology" must have способностью:

- abstract thinking, analysis, synthesis of a seismological database; be ready to act in non-standard situations, bear social and ethical responsibility for decisions made, show a desire for self-development, self-realization, and the use of creative potential.
- independently acquire, comprehend, structure and use new knowledge and skills in professional activities, develop their innovative abilities;
- be able to formulate research goals independently and establish a logical sequence for solving professional tasks; apply in practice knowledge of fundamental and applied sections of disciplines that determine the orientation (profile) of the master's degree program.
- possess professional competencies (PC) corresponding to the type of professional activity that the master's degree program is focused on.

Graduates of the Master's degree program "Seismology" must be способны:

- to form diagnostic solutions to seismological problems by integrating fundamental sections of seismological sciences and specialized knowledge; b) to be able to independently conduct scientific and methodological work and research in seismology, generalize and analyze experimental information, draw conclusions, formulate conclusions and recommendations;
- conduct independent research and monitoring work; be able to professionally operate modern equipment and devices.

Graduates of the Master's degree program "Seismology" must:

- be able to use effective methods of processing and interpreting complex information to solve tasks; create and explore models of the studied objects based on the use of in-depth theoretical and practical knowledge;

- have communication skills to present their suggestions and recommendations in oral and written forms;
- be able to use effective methods of processing and interpreting complex information to solve production problems; build and explore models of the studied objects based on the use of in-depth theoretical and practical knowledge;
- critically analyze, present, defend, discuss and disseminate the results of their professional activities;
- possess the skills of drawing up and processing scientific and technical documentation, scientific reports, reviews, reports and articles;
- be competent in the search and interpretation of technical information with the use of various search engines (patent search, literary review of magazines and books, the Internet), in the selection and creative use of modern equipment for solving scientific and practical problems of oil and gas and ore geophysics;
- be socially mobile, be able to adapt to new situations in a professional environment;
- have the ability to perceive diversity and intercultural difference, appreciate diverse approaches to understanding and solving problems of society.
- be able to organize cooperation in a team, show creativity and breadth of interests to solve interdisciplinary problems.
- to perceive social, ethnic, confessional and cultural differences with tolerance, to appreciate the traditions of other cultures, their diversity in modern society;
- be capable of criticism and self-criticism, have skills of interaction and cooperation, be ready to accept the role of a team leader;
- be ready to communicate orally and in writing in Kazakh, Russian and foreign languages to solve the tasks of professional activity;
- to 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 and mathematics
2	Code and classification of training areas	7M053 Physical and chemical sciences
3	Group of educational programs	M091 Seismology
4	Name of the educational program	7M05302 Seismology
5	**Brief description of the educational program** The Master's program in the direction of "Seismology" provides: a) training of highly qualified specialists in the field of seismological methods of seismic hazard assessment, risk and earthquake forecasting; b) obtaining high-quality and professional knowledge on forecasting the places of occurrence, strength and recurrence of earthquakes; conducting detailed studies of earthquake preparation processes in a real physical and geological environment, displacements of Earth blocks and other transformations of the environment in foci, assessing the parameters of the focus, identifying earthquake precursors and those who are able to develop long-term, medium-term and short-term earthquake forecasts, methods of controlling the seismic process, to assess the possibility of anthropogenic (man-made) influence on seismicity; c) professional solution of engineering and seismological problems in the study of earthquake-induced seismic wave field near the hearth, the study of strong seismic movements of the Earth's surface and the interaction of soil with the structure, the development of methods and conducting seismic micro-zoning, determining the impact of earthquakes on the hydrosphere and the Earth's atmosphere. d) qualified research away from the earthquake source when studying the wave seismic field at distances exceeding the length of the seismic wave, as well as the development and use of seismic methods of cognition of the internal structure of the Earth. Adjacent to this direction is the study of seismic noise on the Earth's surface - microseism. The applied tasks include registration and recognition of underground nuclear tests. e) obtaining high-quality and professional knowledge by undergraduates on the stages and rational complexes of seismogeophysical research, processing, interpretation and modeling of the data obtained	
6	Purpose of the EP	Training of highly qualified specialists of seismologists of international level, capable on the basis of innovative methods and technologies of seismogeophysical research and with the use of advanced hardware and methodological and modern software for conducting research and professional activities: - organize and carry out registration, processing and complex analysis of seismological data, solve complex tasks on long-term, medium-term and short-term algorithms for forecasting natural and man-made earthquakes; - to build maps and sections characterizing regional and local seismicity, to identify seismogenerating zones in areas of anthropogenic activity, to identify the consequences of strong natural and man-made earthquakes; - apply methods and techniques of seismotectonic and paleoseismogeological studies, assess seismic hazard, conduct regional and detailed seismic zoning and micro-zoning; perform engineering analysis of the consequences of earthquakes and methods of earthquake protection using methods to ensure the seismic safety of the population and territories with special seismic

		protection systems. - perform mathematical analysis of seismic fields and carry out statistical calculations of seismic regime parameters, build earthquake preparation models, identify preparation stages and earthquake precursors, classify their types.
7	Type of EP	New
8	The level of the NQF	7
9	IQF Level	7
10	Distinctive features of the EP	no
11	**Basic knowledge, skills and abilities (B):** B1 –the ability to independently acquire, comprehend, structure and use new knowledge and skills in professional activities, develop their innovative abilities; B2 – the ability to put into practice knowledge of fundamental and applied sections of seismogeophysical disciplines that determine the orientation (profile) of the Master's program in seismology; B3 – the ability to independently design and carry out research activities in the field of seismology using modern research methods and information and communication technologies and on the basis of complex geophysical and interdisciplinary research; B4 – the ability to professionally select and creatively use modern scientific and technical equipment to solve scientific and practical problems of seismology; B5 – understanding of the essence and significance of the interrelation of theoretical and practical research in seismology, allowing to effectively and rationally study the processes and mechanisms of seismicity; reduce the risks of man-made impacts on industrial and civil facilities; B6 – the ability to solve complex problems of seismology using innovative technologies; B7 – knowledge of the goals and objectives of fundamental and applied geophysical research in the areas of activity, the basic principles and methods of their organization; the main sources of information and requirements for the presentation of information materials. B8 – proficiency in the preparation and execution of scientific and technical documentation, scientific reports, reviews, reports and articles in the areas of seismology; B9 – the ability to critically analyze, present, defend, discuss and disseminate the results of their professional activities; B10 – readiness to use modern methods and technologies of scientific communication in the state and foreign languages to solve urgent problems of seismology. **Professional Competencies (PC):** PC1 – the ability to form diagnostic solutions to professional problems of seismology by integrating fundamental and applied sections of geophysics (including gravimagnetic exploration, geoelectrics, seismology and seismic exploration) and specialized geological and geophysical knowledge (including physical processes occurring in the Earth and the internal structure of the Earth) to solve problems of seismology; PC2 – to know the promising directions of development and problems of seismology, the current level of elaboration of problems; PC3 – the ability to independently formulate research goals, establish the sequence of solving professional problems in the areas of seismology with the help of modern equipment and equipment, software and information technologies using the latest domestic and foreign experience; PC4 – the ability to independently conduct scientific experiments and research in seismology, generalize and analyze experimental information, draw conclusions, formulate conclusions and 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 fields of knowledge; PC6 – the ability to create and explore models of the studied objects based on the use of in-depth theoretical and practical knowledge in the field of seismology; PC7 - be able to independently compile and submit research projects, prepare and coordinate technical specifications for the development of design solutions; PC8 - possess the skills of professional operation of modern seismological equipment and instruments;	

	PC9 - to identify and systematize the main ideas in scientific publications; to critically evaluate the effectiveness of various approaches to solving seismological problems; to formulate an independent view of the proposed problem taking into account the latest domestic and foreign experience; PC10 - be able to manage scientific and production work in solving complex problems of seismology at the stages of design, execution (including processing, analysis and interpretation), preparation of reports and presentation of results; PC11 - own computer software packages designed to work with a complex of geological and geophysical data. PC12 – master the basic methods of collecting and analyzing, storing and processing scientific and technical information. PC13 - the ability to conduct seminars, laboratory and practical classes (within the framework of domestic and international educational programs) in the field of geophysics (in accordance with the specialization) using modern educational technologies; **Universal, social and ethical competencies (U):** U1 – understanding and practical use of the norms of a healthy lifestyle, including issues of prevention, the use of physical culture to improve performance; U2 – knowledge of the state, Russian and one of the most common foreign languages at a level that ensures human communication; U3 – awareness of the need to acquire the ability to study independently and improve their qualifications throughout their working life; U4 – readiness for self-development, self-realization, use of creative potential; U5 - the ability to plan and solve problems of their own professional and personal development. U6 - willingness to act in non-standard situations, to bear social and ethical responsibility for the decisions taken; U7 - готовность действовать в нестандартных ситуациях, нести социальную и этическую ответственность за принимаемые решения. U8 - possess the skills of systematic logical thinking in the analysis of scientific data and the formulation of practical tasks of seismological research. **Special and managerial competencies (S):** S1 – independent management and control of the processes of labor activity within the framework of the strategy, policy and goals of the organization, discussion of the problem, reasoning of conclusions and competent handling of information; S2 – willingness to lead a team in the field of their professional activities, tolerantly perceiving social, ethnic, confessional and cultural differences; S3 – know and master the basic management functions (decision-making, organization, motivation, control) and methods of their implementation; S4 – have organizational skills, be able to create mobile working groups to fulfill their goals and be able to manage such a group, be able to protect their rights and require them to fulfill their duties. S5 – possess: methods and technologies of interpersonal communication, public speaking skills.
12	**Learning outcomes of the educational program:** LO1: to show deep theoretical and practical knowledge of seismology based on the features of the cognitive process and scientific worldview; LO2: understand and define the methodology of professional solution of seismology problems based on deep integrated geological and geophysical knowledge and the fundamentals of the philosophy of science; LO3: apply systematic knowledge and skills for the organization and execution of seismological surveys, independently set research goals and choose the methodology of work based on competencies for the implementation of cognitive activity LO4: analyze and generalize complex geological and geophysical data to determine interpretation criteria, combine and compare a priori and field information to obtain effective materials of seismological surveys using modern achievements of science and technology in the field of seismology; LO5: evaluate modern domestic and foreign scientific publications and research results to form an independent opinion in the field of seismology, critically analyze, present, defend, discuss and disseminate the results of their professional activities; LO6: to use modern methods of teaching, education and educational technologies in pedagogical activity and in the management of research works of students;

	LO7: to carry out communicative interaction in a team, to apply knowledge on the philosophy of science to solve problems of professional and personal development, to use knowledge, skills and abilities in professional activity.	
13	Form of training	full - time
14	Duration of training	2
15	Volume of loans	120
16	Languages of instruction	Russian/Kazakh
17	Academic degree awarded	master
18	Developer(s) and authors:	Professor Abetov A.E.

4.2. The relationship between the achievability of the formed learning outcomes and academic disciplines according to the educational program

№	Name of the discipline	Brief description of the discipline	Number of credits	Generated learning outcomes (codes)						
				LO1	LO2	LO3	LO4	LO5	LO6	LO7
Cycle of basic disciplines University component										
1	History and philosophy of science	The purpose of studying the discipline is the formation of in–depth knowledge on the development of history and philosophy, the place and role of scientific knowledge, models, research and methods of scientific knowledge. Studying the course allows you to reveal the connection between philosophy and science, highlight the philosophical problems of the latter and scientific knowledge, the main stages of the history of science, focus on its philosophy, modern problems of the development of scientific and technical reality	1/0/1		✓			✓		✓
2	English (professional)	The course is designed to develop foreign language communication skills in the professional and academic field. Introduces students to the general principles of professional and academic intercultural oral and conversational communication using modern pedagogical technologies (round table, debates, discussions, analysis of professionally-oriented cases, design). The course ends with a final exam. Undergraduates also need to study independently (MIS).	0/0/3					✓	✓	✓
3	Higher school pedagogy	The course is intended for scientific and pedagogical magistracy of all specialties. As part of the course, undergraduates	1/0/1			✓			✓	✓

		will master the methodological foundations of higher school pedagogy, learn how to use modern pedagogical technologies, plan and organize the processes of teaching and upbringing, master the communicative technologies of subjective interaction between a teacher and a student in the educational process of a university. Undergraduates also study human resource management in higher education institutions.								
4	Management Psychology	The course is designed to study psychology of management, psychological impact of management activities. The main objective of the course is to analyze the psychological conditions and features of managerial activity in order to achieve results and quality of work in management. Also, undergraduates study marketing of education, human resource management in research organizations, information and communication technologies in the field of education and management of the educational process in higher education.	1/0/1			✓			✓	✓
5	Pedagogical practice	Pedagogical practice is an obligatory component that consolidates the knowledge and skills acquired by undergraduates as a result of mastering theoretical disciplines, develops practical skills and contributes to the formation of universal и общепрофессиональных компетенций. The purpose of pedagogical practice is to study the basics of pedagogical and educational–methodical work in universities, mastering pedagogical skills of conducting training sessions and preparing	6			✓		✓	✓	✓

		teaching materials in the disciplines of the educational program "Seismology". The base of pedagogical practice is the Department of Geophysics of the KazNRTU named after K.I.Satpayev. The objectives of the practice are to gain experience in teaching work, as well as: - formation of a holistic view of pedagogical activity, pedagogical systems and the structure of higher education; - development of stable skills of practical application of professional and pedagogical knowledge obtained in the process of theoretical training; - development of professional and pedagogical orientation of undergraduates; familiarizing them with real problems and tasks solved in the educational process; studying methods, techniques, technologies of pedagogical activity in higher education; - development of personal and professional qualities of a teacher.								
Cycle of basic special disciplines 1 Component of choice										
6	Fundamentals of seismology	The course is basic for studying seismology as a physical discipline. It examines the physical concepts underlying modern structural and focal seismology: the theory of elasticity with an application to the theory of waves, rheology and the basics of the theory of destruction of materials. The course enables undergraduates to master modern methods of describing the mechanical properties of materials, methods of solving dynamic problems of mechanics of elastic-viscous media, to get an idea of the	2/1/0	✓	✓		✓	✓		✓

		physics of fracture and the theory of strength of heterogeneous materials. The focus will be on: elements of tensor analysis, deformations and stresses in a continuous medium, the equation of motion, elasticity, equations of motion of an elastic medium and elastic waves, elementary rheological bodies, linear rheological bodies, the nature of the viscosity of solids, fundamentals of physics of strength and fracture of materialsв.									
7	Seismic waves in the Earth's crust	The course content is aimed at the acquisition by undergraduates of a modern level of knowledge about the fundamental laws of radiation and propagation of seismic waves in the Earth's crust, theories and methods of studying its internal structure with the help of seismic waves, modern ideas about the nature and basic laws of seismicity of the Earth as a whole and the seismic regime of various areas, modern models of earthquake physics and its preparation processes. The focus will be on the formation of basic knowledge about modern seismic studies of the internal structure of the Earth's crust, based on solving problems of mathematical physics, separate sections of beam and diffraction seismics to understand the main list of tasks of scientific research and work in the field of constructing spatial kinematic and dynamic models of the structure of the Earth as a whole and its individual areas; to teach modern methods of solving direct and inverse problems.	2/0/1	✓	✓		✓	✓		✓	
8	Geophysical methods of studying	The discipline studies the physical and mathematical foundations of	2/0/1	✓	✓	✓	✓			✓	

	the Earth's crust	geophysical methods, electrical, gravitational, magnetic, seismic and geothermal exploration; principles of integration of geophysical, geochemical and geological methods of studying the subsurface; regional, deep, structural, prospecting and mapping geophysical research. The course examines the magnetic, density, electrical, elastic, radioactive and thermal properties of rocks. Principles of paleomagnitology. Fundamentals of geological interpretation of gravitational and magnetic anomalies. Electrical and thermal models of the Earth's crust and lithosphere, etc.								
9	Geophysical methods of studying the Earth's crust and lithosphere	The course content is aimed at the acquisition by undergraduates of practical-operational and theoretical-informational knowledge on the deep structure, material composition and dynamics of the Earth's crust and lithosphere based on the results of a comprehensive interpretation of methods of gravity-magneto-electric and seismic exploration, geothermy and radiometry, drilling of ultra-deep wells. The focus will be on the physical and mathematical foundations of geophysical methods, methods of field work; approaches to solving direct and inverse problems: qualitative and quantitative interpretation of geological and geophysical data; on the study of the formation composition, conditions of occurrence and condition of rocks (including dynamics) of rocks in the Earth's crust and lithosphere;	2/0/1	✓	✓	✓	✓			✓

		At the end of the course, undergraduates will acquire competencies in processing, interpretation and modeling of geological and geophysical data, construction of geodynamic and geostatic models of the lithosphere; tectonic zoning of the foundation of platforms and orogenic areas; prediction of the internal structure of deformation-stressed zones.								
10	The deep structure of the Earth's crust and lithosphere according to regional geophysical studies	The discipline studies the physical and mathematical foundations of geophysical methods, electrical, gravitational, magnetic, seismic and geothermal exploration; principles of integration of geophysical, geochemical and geological methods of studying the subsurface; regional, deep, structural, prospecting and mapping geophysical research. The course examines the magnetic, density, electrical, elastic, radioactive and thermal properties of rocks. Principles of paleomagnitology. Fundamentals of geological interpretation of gravitational and magnetic anomalies. Electrical and thermal models of the Earth's crust and lithosphere, etc. The focus of attention will be put on the acquisition by undergraduates of practical-operational and theoretical-information knowledge on: - the deep structure and dynamics of the earth's crust, the formulation and content of tasks, the complex of geophysical research methods, the principles of interpretation and the main geological results. - hemodynamic and hemostatic models of the lithosphere and plate tectonics;	2/0/1	✓	✓	✓	✓			✓

		- tectonic zoning of the foundation, platforms and orogenic areas; - прognosis of the internal structure of strain-stressed zones.								
11	Project management	The course program is based on the international standards PMI PMBOK, IPMA ICB and national standards of the Republic of Kazakhstan in the field of project management recognized by the business community. The features of organizational management are studied. System practices, methods and procedures are considered, consideration in the innovative activity of bodies with psychological aspects of team building, communication and interaction with stakeholders. At the end of the course, the master's student has knowledge of the main components of project management, with an emphasis on modern behavioral models of project-oriented business development management.	2/0/1	✓		✓		✓	✓	✓
Cycle of special profile disciplines University component										
12	Fundamentals of seismotectonics	The course content is aimed at acquiring a system of knowledge about the nature of seismicity, the characteristics of geological structures that generate earthquakes. The focus will be on methods and techniques of seismotectonic studies; on the characteristics of earthquakes and their generating forces in the bowels of the Earth; features of the distribution of seismically active zones. At the end of the course, undergraduates	2/0/1	✓	✓		✓	✓		

		will acquire competencies in the application of methods and techniques of seismotectonic and paleoseismogeological studies, seismic hazard assessment, regional and detailed seismic zoning, micro-zoning; knowledge of the patterns of earthquake distribution on continents and oceans, on the boundaries of lithospheric plates and in intraplate geodynamic settings.								
13	Research practice	The objectives of the research practice are: - consolidation of skills of scientific or industrial work in seismology; collection of theoretical, laboratory and field material for writing a master's thesis; - formation of skills and abilities in the preparation of scientific and technical reports and public presentations; - practical use of the results of scientific research, including publications, promotion of the results of their own scientific activities; The objectives of the research practice are: - direct participation in research or production work; - acquisition of professional competencies in accordance with the types and tasks of geological exploration; - involvement of a master's student in a scientific discussion in a creative team, development of public speaking skills; - mastering the technical means of presenting a scientific result. Forms of research practice: field, laboratory, desk.	4		✓		✓	✓	✓	✓

		The content of a master's research practice depends on the focus of the task and the topic of the master's thesis. It is directly related to the nature and direction of the scientific activity of the organization in which the undergraduate is practicing. The research practice plan is drawn up individually for each undergraduate and is a program of theoretical, experimental or fieldwork in the field of oil and gas or rune geophysics. This plan provides for collection of seismological information on the object of study; analysis of data on the seismicity of the studied area; formulation and justification of specific research works; conducting field, experimental or computational work; processing and interpretation of the materials obtained.								
Cycle of special profile disciplines Component of choice										
14	Quantitative Seismology (introduction)	The course is based on the study of the deep structure of the Earth based on calculations of seismological characteristics; propagation of seismic waves in the Earth; global and regional seismicity; theory of elasticity in seismology, the analysis of the wave field in an infinite homogeneous medium. The focus will be on obtaining knowledge on stress and strain tensors, on the description of seismic sources and seismic moments, the seismic moment tensor, elastic energy and elastic waves from a point source.	2/0/1	✓	✓	✓	✓			✓
15	Seismic statistics	The course is aimed at obtaining knowledge and modern ideas about the	2/0/1	✓	✓	✓		✓		✓

		statistical patterns of seismic statistics in the energy, spatial and temporal domains. Study of the Gutenberg-Richter law, Sadovsky hierarchy, fractal geometry of seismicity, temporal grouping of earthquakes. Particular attention is paid to the seismic cycle and the recurrence of earthquakes; the problem of comparing the results of seismic statistics with the conclusions of physical theories of destruction. Problems of spatial-temporal connectivity and self-similarity of the seismic process, etc.								
16	The deep structure of the Earth according to seismological data	The course focuses on the study of the fundamental laws of the propagation of seismic waves in the Earth, the types of seismic waves and their main characteristics, general ideas about the use of seismic waves in the study of the internal structure of the Earth. - The focus of attention will be put on obtaining sustainable knowledge by undergraduates опсейсмической томографии; - methods of processing digital seismic data and seismic recording equipment; - the place of seismology in Earth sciences. - seismic properties of soils. - seismological zoning and prediction of seismic impacts.	2/0/1	✓	✓		✓	✓		✓
17	Theoretical foundations, registration, processing and interpretation of seismic data	The course focuses on the study of the physical and geological foundations of seismic exploration; theory of elasticity; principles of geometric seismics; initial and boundary conditions; seismic waves in absorbing media; types of real media; elastic	2/0/1	✓	✓		✓	✓		✓

		waves in homogeneous and anisotropic media; principles of superposition; seismic models of the medium and seismic boundaries; seismic waves and hodographs in multilayer, gradient and layered-gradient environments. The focus of attention will be put on the consideration and analysis of systems and devices for digital registration of seismic signals; telemetry seismic recording systems.								
18	Software-processing complexes in seismology	The course examines the use of industry software packages in the processing of geophysical data. Special attention is paid to the formation of practical skills of working with software tools for processing data obtained as a result of seismic and geophysical work, as well as algorithms of programs implementing information transformation in the study of the Earth's crust. The focus of attention is put on the analysis of the results obtained taking into account the existing world experience, presentation of the results of the work, justification of the proposed solutions at a high scientific, technical and professional level.	2/0/1	✓	✓	✓	✓			
19	Software-processing complexes and technology of computer processing of seismology data	The course focuses on the acquisition of fundamental knowledge on the technology of digital processing of seismogeophysical data, the formation of ideas about integrated systems for processing and interpreting these data, the information foundations of seismological methods and related factors.	2/0/1		✓		✓	✓		

		The focus will be on the study of methods of processing and complex interpretation of seismogeophysical materials; principles and modern methods of analysis and mathematical processing of seismological information; practical development of programs for processing seismogeophysical data. At the end of the course, undergraduates will acquire competencies in the application of seismic and geophysical data processing technology, skills in working with specialized systems for processing and interpreting this data.								
20	Earthquake damage. Methods of assessing the situation	The course content is aimed at the acquisition by undergraduates of a knowledge system for determining the volume, nature and degree of destruction of objects and their elements (emergency zones) during earthquakes, analyzing the impact of destruction and other negative impacts of emergencies on the population and the stability of the functioning of the OE. The focus will be on methods of assessing damage during earthquakes through familiarization with historical and modern seismic data, mastering the skills of calculating the consequences of an earthquake and calculating damage to administrative structures and residential buildings after earthquakes. At the end of the course, undergraduates will acquire competencies in engineering and economic calculations of the consequences of earthquakes; calculations of demographic and political consequences	2/0/1	✓	✓		✓	✓		✓

		from them, calculation of the necessary forces and means for emergency rescue and other urgent work (AS and DNR), i.e. emergency response.								
21	Technogenic seismicity	The content of the course is aimed at acquiring a system of knowledge about the factors determining technogenic seismicity in the deposits of groundwater, oil and gas, and solid minerals, the possible consequences of strong man-made earthquakes. The focus will be on the types of man-made earthquakes and their causes; seismic waves excited during earthquakes and recorded at seismic stations; methods and analysis of seismological and seismotectonic materials for assessing man-made seismic hazards; organization of geodynamic monitoring at deposits of solid minerals, oil and gas. At the end of the course, undergraduates will acquire competencies in drawing up maps and sections characterizing regional and local seismicity, methods for identifying seismogenerating zones in areas of anthropogenic activity, and identifying the consequences of strong man-made earthquakes.	2/0/1	✓	✓		✓	✓		✓
22	Technogenic geophysical phenomena	The course is aimed at acquiring knowledge about the main elements of man-made geophysical phenomena and the factors determining them; possible consequences of strong man-made earthquakes. The focus will be on the study of man-made geophysical phenomena, the factors determining the causes and nature of these	2/0/1							

		phenomena, their classification, prevention of man-made disasters based on monitoring of their precursors..								
23	Seismic mode	The course aims to provide undergraduates with knowledge and modern ideas about: - seismic regime, as about the totality of earthquake foci manifested in space, time and energy; - various aspects of seismicity and their practical use; - assessment of the degree of seismic hazard of territories and prediction of the possibility of strong earthquakes. The focus of attention will be put on: • to study the regularities of the development of the seismic regime during the preparation of strong seismic events, including the depth of earthquake foci and their repeatability, the maximum possible earthquake energy and the nature of its decrease with distance; • methods of studying the seismic regime, which is based on the law of recurrence of earthquakes. • Determination of seismic regime parameters for different areas. At the end of the course, undergraduates will acquire knowledge of: - seismic precursors of earthquakes, about their statistical and physical aspects; - classification of harbingers; - methods for detecting anomalies in variations of seismic regime parameters caused by the local earthquake preparation process.	2/0/1	✓	✓		✓	✓		✓

24	Seismic regime and prediction of seismic hazard in Kazakhstan	The course content is aimed at the acquisition by undergraduates of a system of knowledge on the seismic regime of the territories of Kazakhstan, its fluctuations in space, time and energy; a detailed study of the seismic regime of the territories of Kazakhstan both to clarify the theoretical aspects of seismicity, and for the practical use of these data, assessing the degree of seismic hazard and forecasting the possibility of strong earthquakes. The focus of attention will be on the study of the energy class and depth of earthquake foci, their recurrence in the seismically active territories of Kazakhstan, on the methods of studying the seismic regime and methods for detecting anomalies in variations of the parameters of the seismic regime, on seismic precursors of earthquakes; their classification, statistical and physical aspects. At the end of the course, undergraduates will acquire the competence of mathematical analysis of seismic fields using modern computing software; to carry out statistical calculations of parameters of the seismic regime.	2/0/1	✓	✓		✓	✓		✓
25	Engineering seismology and seismic resistance	The course content is aimed at the acquisition by undergraduates of a system of knowledge on the basics of engineering seismology, assessment of the strength and intensity of earthquakes, seismic zoning and micro-zoning. The focus of attention will be put on the study of types of seismic zoning (general and detailed seismic zoning, seismic micro-zoning), differing in content, methods, scale	2/0/1	✓	✓	✓	✓			✓

		and completeness of the study; seismic impact, its characteristics in intensity parameters in points or quantitative characteristics of vibrations recorded by special devices. At the end of the course, undergraduates will acquire competencies in engineering analysis of earthquake consequences, analysis of consequences and methods of earthquake protection, methods of ensuring seismic safety of the population and territories, special seismic protection systems.								
26	Zoning of seismic risks and preliminary assessment of the impact of strong earthquakes	The course content is aimed at the acquisition by undergraduates of a system of knowledge on the scientific and methodological foundations of calculating seismic risks, preliminary assessment of the degree of damage to buildings and destruction of structures, population losses in densely populated cities during strong earthquakes, processing and interpretation of the information received on the degree of destruction of industrial and civil construction facilities. The focus of attention will be put on the stages of work on the zoning of seismic hazard, on solving the tasks set with the study of the seismic regime and the current level of the initial seismicity of the territory, the allocation of seismically active areas and the assessment of their probable seismic potential. At the end of the course, undergraduates will acquire the competence of zoning the seismic risk of cities and settlements, building seismic models for the most typical	2/0/1	✓	✓	✓	✓	✓		✓

		regions, carrying out theoretical calculations of the main parameters of seismic impacts for them, predicting the degree of destruction on the MSK-64 scale. evaluate the reliability and accuracy of the results obtained.								
27	Physics and prediction of earthquakes	The content of the course is aimed at the acquisition by undergraduates of a system of knowledge on the physics of earthquake preparation and the phases of algorithms for their prediction: long-term, medium-term and short-term); seismic, deformation, electromagnetic, geochemical and other precursors, the nature and concepts of the earthquake source and seismic source models; with the physical parameters of earthquakes; energy, geometric and dynamic characteristics of the earthquake source; with errors and uncertainties of estimates. The focus will be on the goals, objectives and types of earthquake forecasting, physical prerequisites for earthquake forecasting. At the end of the course, undergraduates will acquire competencies in building earthquake preparation models, identifying preparation stages and earthquake precursors, their types, forecasting methods and algorithms, and analyzing a set of predictive parameters..	2/0/1	✓	✓		✓	✓		✓
28	Harbingers of earthquakes	The aim of the course is to form basic knowledge about the patterns and physical nature, parameters and methods of identifying tectonic and geophysical precursors; on the use of these precursors in order to develop an earthquake prediction	2/0/1	✓	✓		✓	✓		

		strategy; on their duration and spatial localization in assessing seismic hazard and seismic risk. A special place in the study of the discipline is given to statistical and physical aspects of tectonic and geophysical precursors of earthquakes, methods for detecting anomalies in variations of parameters of geophysical fields and anomalies in tectonic tension caused by the earthquake preparation process are considered. At the end of the course, undergraduates will acquire competencies in predicting tectonic earthquakes, using algorithms for long-term, medium-term, and short-term earthquake forecasts.								
29	Earthquake damage assessment methods	The content of the course is aimed at obtaining the necessary knowledge by undergraduates on: - determination of the volume, nature and degree of destruction of objects and their elements (emergency zones); - calculation of the necessary forces and means for emergency rescue and other urgent work (AS and DPR), i.e. elimination of the consequences of an emergency; - analysis of the impact of destruction and other negative impacts of emergencies on the population and the stability of the functioning of the OE; - development of proposals for the organization and management of the AU and the DPR. A special place in the study of the discipline is given to mastering the skills of: calculating the consequences of an	2/0/1	✓	✓	✓	✓			✓

		earthquake; damage to administrative structures and residential buildings after earthquakes; classification of buildings and administrative structures. At the end of the course, undergraduates will acquire competence in calculations: - engineering and economic consequences of an earthquake; - demographic consequences of the earthquake; - political consequences of the earthquake.								
30	Seismic monitoring of underground nuclear and industrial explosions. tech. geofiz.phenomena.	The discipline introduces undergraduates to: - a system of basic scientific knowledge and research methods in the field of seismology of underground nuclear and industrial explosions and ensuring seismic safety in the mining industry; - methodology of seismological monitoring of underground nuclear and industrial explosions; methods of their detection and recognition; - factors determining man-made seismic impacts and possible consequences of strong man-made earthquakes; - the necessary knowledge about the main elements of man-made geophysical phenomena and the factors determining them. Course objectives: - to give basic concepts about monitoring of underground nuclear and industrial explosions, types of man-made earthquakes, seismic waves excited during earthquakes and recorded at seismic stations;	2/0/1	✓	✓		✓	✓		✓

		- to familiarize with the methodology and schematic diagram of the analysis of seismological and seismotectonic materials for the assessment of man-made seismic hazard, with the methods of identification of underground nuclear and industrial explosions; - to show the important role of research on the study of the consequences of strong man-made earthquakes; principles of mapping and sections characterizing regional and local seismicity, methods for identifying seismogenerating zones.								
31	Geodynamic monitoring and forecast of dangerous technogenic processes	The development of the discipline is aimed at - obtaining knowledge about the theoretical foundations of geodynamic monitoring and forecasting of dangerous technogenic processes; - familiarization with the research methodology to obtain objective and optimal information for the development of recommendations for optimizing the operation of the "engineering structure – geological environment" system; - study of the methodology of geodynamic monitoring of the geological environment to solve the problem of rational and environmentally safe use of natural resources by humans.	2/0/1	✓	✓		✓	✓		✓
32	Monitoring of natural and man-made seismicity	The purpose of the course is to study a complex of works aimed at registration, processing and analysis of seismic signals of natural and man-made origin. During the training process, the following will be considered: - high-tech solutions in the field of hardware and software, methods of registering	2/0/1	✓	✓	✓	✓			✓

		ground movement and methods of processing recorded information; - interpretation of the results of the study of natural and induced seismicity. - possible risks associated with the consequences of seismic impacts. - possible risks associated with the consequences of seismic impacts.								

5. Curriculum of the educational program

KAZAKH NATIONAL RESEARCH TECHNICAL UNIVERSITY named after K.I.SATPAEV

SATBAYEV UNIVERSITY

I APPROVE
Chairman of the Board
Rector of KazNRTU
named after K.I.Satpayev
_____ M.M.Begentaev
«____» _____ 2022 y.

CURRICULUM

EDUCATIONAL PROGRAMS for recruitment for the 2022-2023 academic year
Educational program 7M05302 Seismology

Group of educational programs M091 Seismology огия

Форма обучения: очная **Срок обучения:** 2 года **Академическая степень:**магистр технических наук

Form of study: full-time **Period of study**: 2 years **Academic degree**: Master of Technical Sciences

Discipline code	Name of disciplines	Cycle	Total amount in loans	Total hours	Classroom volume of lek/lab/pr	SIS (including SISM) in hours	Form of control	Distribution of classroom classes by courses and semesters			
								I course		2 course	
								1 term	2 term	3 term	4 term
CYCLE OF BASIC DISCIPLINES (DB)											
M-1. Basic training module (university component)											
LNG210	English (professional)	BD UC	5	150	0/0/3	105	Э	5			
HUM214	Management Psychology	BD UC	3	90	1/0/1	60	Э		3		
HUM212	History and philosophy of science	BD UC	3	90	1/0/1	60	Э		3		
HUM213	Higher school pedagogy	BD UC	3	90	1/0/1	60	Э	3			
M-2. Module of special seismological disciplines 1											

GPH261	Fundamentals of seismology	BD CC	5	150	2/1/0 2/0/1	105	Э	5			
GPH286	Geophysical methods of studying the Earth's crust	BD CC	5	150	2/0/1	105	Э	5			
GPH299	Geophysical methods of studying the Earth's crust and lithosphere										
GPH700	The deep structure of the Earth's crust and lithosphere according to regional geophysical studies										
MNG704	Project management	BD CC	5	150	2/0/1	105	Э			5	
CYCLE OF PROFILE DISCIPLINES (PD)											
M-3. Module of special seismological 2											
GPH285	Fundamentals of seismotectonics	PD UC	5	150	2/0/1	105	Э	5			
GPH750	Quantitative seismology	PD CC	5	150	2/0/1	105	Э			5	
GPH751	Seismic statistics										
GPH753	Seismic waves in the Earth's crust	PD CC	5	150	2/0/1	105	Э		5		
GPH754	The deep structure of the Earth according to seismological data										

GPH755	Theoretical foundations, registration, processing and interpretation of seismic data										
GPH288	Software-processing complexes and technology of computer processing of seismology data	PD CC	5	150	2/0/1	105	Э			5	
GPH269	Technology of computer processing of seismic data										
GPH266	Software-processing complexes in seismology										
GPH275	Earthquake damage. Methods of assessing the situation	PD CC	5	150	2/0/1	105	Э			5	
GPH720	Technogenic seismicity										
GPH242	Technogenic geophysical phenomena										
GPH289	Seismic mode	PD CC	5	150	2/0/1	105	Э		5		
GPH703	Seismic regime and prediction of seismic hazard in Kazakhstan										
GPH714	Engineering seismology and seismic resistance	PD CC	5	150	2/0/1	105	Э		5		
GPH749	Fundamentals of engineering seismology										

GPH718	Zoning of seismic risks and preliminary assessment of the impact of strong earthquakes										
GPH287	Physics and prediction of earthquakes	PD CC	5	150	2/0/1	105	Э			5	
GPH722	Harbingers of earthquakes										
GPH721	Earthquake damage assessment methods										
GPH267	Seismic monitoring of underground nuclear and industrial explosions. technogenic geophysical phenomena.	PD CC	5	150	2/0/1	105	Э			5	
GPH723	Geodynamic monitoring and forecast of dangerous technogenic processes										
GPH724	Monitoring of natural and man-made seismicity										
M-4. Practice-oriented module											
AAP229	Pedagogical practice	BD UC	6						6		
AAP256	Research practice	PD CC	4								4
M-5. Research module											

AAP251	Research work of a master's student, including internship and completion of a master's thesis	RWM S UC	2					2			
AAP241	Research work of a master's student, including internship and completion of a master's thesis	RWM S UC	3						3		
AAP254	Research work of a master's student, including internship and completion of a master's thesis	RWM S UC	5							5	
AAP255	Research work of a master's student, including internship and completion of a master's thesis	RWM S UC	14								14
M-6. Module of final certification											
ECA205	Preparation and defense of a master's thesis	FC	12								12
	Total by UNIVERSITY:							30	30	30	30
								60		**60**	

Number of credits for the entire period of study					
Cycle code	Cycles of disciplines	Credits			
			university component (UC)	component of choice (CC)	Total
BD	Cycle of basic disciplines		20	15	35
PD	Cycle of profile disciplines		9	40	49
	Total for theoretical training:	***0***	***29***	***55***	***84***
	RWMS				***24***
FC	Final certification	12			12
	TOTAL:	**12**	**29**	**55**	**120**

Decision of the Academic Council of KazNRTU named after K.Satpayev
Protocol No. 13 of "28" 04 2022

Decision of the Educational and Methodological Council of Kazntu named after K.Satpayev.
Protocol No. 7 of "26" 04 2022

Decision of the Scientific Council of the Institute of Geology and Oil and Gas Business
Protocol No. 4 of "30" 12 2021

Vice-Rector for Academic Affairs **B.A.Zhautikov**

Director of the Institute **A. H.Syzdykov**

Head of the Department **A.E.Abetov**

Representative of the Specialty Council

from employers **D.M.Khitrov**

6. Additional educational programs (Minor)

Name of additional educational programs (Minor) with disciplines	Total number of credits	Recommended semesters of study	Documents on the results of the development of additional educational programs (Minor)
no			