NJSC «Kazakh national research technical university named after K. I. Satpayev»

Institute of Geology, Oil and Mining n.a. K. Turysov

Department Of Geophysics

EDUCATIONAL PROGRAM CURRICULUM PROGRAM

7M05302 – «SEISMOLOGY»

Master of technical sciences

in the direction
7M053 Physical and chemical Sciences

on the basis of specialty
Specialty classifier: 6M075600-Seismology

1st edition
in accordance with the SES of higher education 2018

Алматы 2021

The program is drawn up and signed by the parties:

From KazNTU named after K. Satpayev:

1. **Director of the Institute** — **A.Kh. Syzdykov**
2. **Head of Department** — **A.E.Abetov**
3. **Secretary of Teaching group Department, Senior Lecturer** — **G.K.Umirova**

From the employer:

1. Doctor of physical-Mat. of Sciences, Deputy Director Of the Institute of geophysical research, N. N. Mikhailova

2. Doctor of phys.-mat. Sciences, academician of IAS, head.laboratory of regional seismicity Of the Institute of seismology, A. B. Sadykov

3. Doctor of physical-Mat. sciences, substitute of Director of Institute of geophysical research, I. N. Sokolov

From partner Universities:

1. Institute of Physics of the Earth RAS, Yu. f Kopishev

Approved at the meeting of the Educational and methodical Council Of the Kazakh national research technical University named after K. Satpayev.
Protocol №4 of 14.01.2020

Qualification:

Level 7M-National qualifications framework
7M053-Physical and chemical Sciences
7M05302-Seismology

Professional competence: providing deep theoretical knowledge and practical skills in the field of fundamental research of the causes, preparation and process of earthquakes, as well as related consequences. The main seismological directions include the study of the seismic process, the earthquake center, the wave seismic field in the distance and near the center (engineering seismology), assessment and zoning of seismic hazard and prediction 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 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 a high motivation to perform professional activities; be able to assess the capabilities of each seismological method and navigate the applicability of individual methods; have skills to work with seismogeophysical equipment and monitoring data, as well as on a computer as a means of information management.

As part of the research team, he must participate in the preparation of reports, abstracts, bibliographies on the subject of scientific research and in the preparation of publications; demonstrate readiness to work on seismic and geophysical instruments, installations and equipment (in accordance with the profile of training); apply in practice the methods of collection, processing, analysis and synthesis of stock and monitoring seismological and geophysical information; participate in the organization of scientific and practical seminars and conferences/

1. Short description of the program

Introduction:

Master's degree in the direction of training "Seismology" provides the formation of graduates of General cultural, General scientific, social, information, professional and pedagogical competencies; the development of such personal qualities as responsibility, the desire for self-development and disclosure of their creative potential, possession of a culture of thinking, awareness of the social significance of the profession of seismologist, the ability to make organizational decisions in various situations and willingness to bear responsibility for them.

The master's program in the direction of" Seismology " stimulates the formation of graduates in-depth fundamental knowledge; abstract thinking and originality of analysis; which go beyond the issues covered by standards and practice; forms the ability to make non-standard decisions in problem situations; adaptation to new situations, revaluation of experience, creating new knowledge based on seismogeophysical research; setting innovative professional tasks in the field of research and practice; search for optimal solutions to professional problems, taking into account their validity, cost, information, social and economic security; management tasks in the conditions of actual production structures.

Master's program in the field of "Seismology" provides:

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

b) the receiving quality and professional knowledge on forecasting centers, strength and frequency of earthquakes; they have made detailed studies of the processes of earthquake preparation in the real physical and geological environment, displacements of blocks of the Earth and other transformations of the environment in the centers, assessment of source parameters, identification of earthquake precursors and are able to develop long, medium and short-term prediction of earthquakes, ways to manage the seismic process, to evaluate the possibility of anthropogenic (manmade) influence on seismicity;

c) professional engineering-seismological challenges 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 structure, development of methods and conducting of seismic zoning, determining the impact of earthquakes in the hydrosphere and atmosphere of the Earth.

d) the qualified carrying out of researches far from the center of earthquakes at studying of a wave seismic field at the distances exceeding length of a seismic wave, and also development and use of seismic methods of knowledge of an internal structure of the Earth. To this area adjoins the study of the seismic noise on the Earth's surface - microseisms. Applications include registration and recognition of underground nuclear tests.

e) obtaining by undergraduates of qualitative and professional knowledge on stages and rational complexes of seismogeophysical researches, processing, interpretation and modeling of the received data.

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

Professors from leading Universities near and far abroad, leading experts from production 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 SOME MES RK, in akimats of regions, cities, departments of dchs and kchs in engineering positions, in research institutes as researchers.

The purpose of the educational program:

Training of specialists in seismology with the international level of competence, able to solve complex problems of seismic waves propagation in the earth's interior, earthquakes and related phenomena on the basis of innovative methods and technologies of seismogeophysical research (including modern software), using advanced means of registration of seismogeophysical potential fields.

Objectives of the educational program:

With the right 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 areas, modern models of physics of the earthquake

- To acquire the ability to plan experiments to study the deep structure of the Earth by seismic methods, to process and interpret the data obtained, to conduct instrumental seismic observations, including in the epicenter zone of strong earthquakes, to determine the parameters of earthquake foci from seismic records and macroseismic manifestations, to plan and carry out work on General, detailed and microseismic zoning, to draw conclusions about the seismic danger of specific territories and objects.

- To master skills of installation and maintenance of the seismic registering equipment, the analysis and interpretation of seismic records, allocation of seismic events, an assessment on seismic waves of position of the center and magnitude of earthquake, determination of intensity of concussions (ballnost) on macroseismic manifestations of earthquake, drawing up and the analysis of maps of seismic zoning.

At the scientific and pedagogical direction:

- advanced theoretical and practical training on seismogeologic and pedagogical activities;
- 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 in universities, successfully carry out research and management activities;
- acquisition of skills of the organization and carrying out seismological researches, obtaining necessary reserve for continuation of scientific work in doctoral studies;
- obtaining knowledge in the field of University pedagogy and psychology and teaching experience in the University.

Area of professional activity of the undergraduate:

The area of professional activity of masters in the direction of training "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, different sections of Earth physics, hydrogeology, Geochemistry. The problem of earthquake prediction is close to the problem of mountain shock prediction, which is studied by mining Sciences. The study of the seismic process comes into 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 application 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 technogenic geological processes; computerized and software-controlled information-measuring and processing systems and complexes.

Types of professional activity:

Masters in the field of training "Seismology" is preparing for research and scientific and industrial professional activity. According to the received fundamental and professional training they can perform the following activities:

a) organizational and managerial activities:

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

b) research activities:

- independent selection and justification of goals and objectives of scientific seismological research;
- development of methods for solving tasks in monitoring, interpretation studies using modern seismic and geophysical 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 research seismological works, preparation of scientific reports, publications, reports, preparation of applications for inventions and discoveries.

c) research and production activities:

- independent preparation and carrying out research, monitoring and interpretation studies in solving practical problems in the field of seismology;

- collection, analysis and systematization of available seismological 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.

d) project activities:

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

e) scientific and pedagogical activity:

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

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 obtained data, as well as measures to ensure seismic safety and reduce the anthropogenic load on the environment.

Areas of professional activity:

At the profile direction: organizational and technological; settlement and design activity in:

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

At the scientific and pedagogical direction:

Organizational and managerial; research; educational (pedagogical) activities of various directions in higher, secondary special and vocational educational institutions, scientific activities in the information services of research institutions, public administration, educational institutions, design organizations, industrial enterprises. In addition, the graduate of the scientific and pedagogical magistracy can carry out activities corresponding to the graduate of the profile magistracy.

2. Scope and content of the program

The volume of the educational program (OOP) of the magistracy is 59 credits regardless of the form of training, the applied educational technologies, the implementation of the magistracy program according to the individual curriculum.

The contents OP the magistracy on the direction "Seismology" through the development of multilevel system of training, soundness and quality of education, continuity of education

and science, unity of training, education, research and innovation aimed at maximum satisfaction of inquiries of consumers **should ensure**:

- training of professional and competitive specialists of the highest qualification in the field of seismology, capable of applying innovative methods in the assessment of seismic hazard, risk and prediction of earthquakes;

preparation of masters who know the methodological basis, equipment, technology and methods of seismic and geophysical works, methods of processing, interpretation and modeling of the obtained seismological data;

- development of masters ' abilities: a) to 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 in the processing, interpretation and modeling of seismological data obtained with the use of modern information technologies; C) to use methods, skills and modern technical means necessary for the assessment of seismic hazard, risk and prediction of earthquakes;

- formation of students: a) ability to find and work with the necessary literature, computer information, databases, and other sources of information to solve problems; b) skills of team work, but to show individuality and, if necessary, to solve problems independently; C) conduct a comprehensive analysis seismogeological data and monitoring seismic work, as well as their results to make management decisions;

- formation at masters of industrial and ethical responsibility, ability to understand a problem and from joint work with various experts, to find optimum variants of decisions, needs in improvement of the knowledge and skill;

- knowledge of modern social and political problems, to know the state, Russian and foreign languages, tools of market economy, safety and environmental protection.

3. Requirements for applicants

The procedure for admission of citizens to the magistracy is established in accordance with the "Standard rules of admission to education in educational organizations that implement educational programs of postgraduate education".

The previous level of education of the applicant – higher education in the direction of training in the field of seismology and / or Geophysics.

The applicant must have a state-issued document on higher education (bachelor's degree in seismology, Geophysics or Geology).

Admission of persons entering Satbayev University is carried out by means of placement of the state educational order (educational grants), as well as payment of training at the expense of own means of citizens and/or other sources.

Admission is carried out according to the applications of the applicant who has completed higher education in full on a competitive basis in accordance with the points in the transcript.

At the" entrance " the applicant must have all the prerequisites necessary for the development of the appropriate educational program of the magistracy. The list of necessary prerequisites is determined by the higher education institution independently.

In the absence of the necessary prerequisites, the entrant is allowed to master them on a paid basis.

4. Requirements for completion of studies and obtaining a diploma

As a result of mastering the master's program, the graduate should have General cultural, General professional and professional competences.

Graduate profile the graduate should: have an understanding of modern trends in the seismic industry; about actual methodological and philosophical problems of seismology; on the contemporary state of economic, political, legal, cultural and technological environment of global business partnerships.

The graduate of the profile magistracy must have the ability to:

- to abstract thinking, analysis, synthesis of seismogeophysical database; to be ready to act in non-standard situations, to bear social and ethical responsibility for decisions, to show the desire for self-development, self-realization, use of creative potential.
- independently acquire, comprehend, structure and use in professional activity new knowledge and skills, develop their innovative abilities;
- be able to independently formulate research goals and establish a sequence of professional tasks;

apply in practice knowledge of fundamental and applied sections of disciplines that determine the direction (profile) of the master's program.

- possess professional competencies (PC) corresponding to the type of professional activity, which is focused on the master's program.

Graduates of the master's program must have:

- deep systematic knowledge in the field seismogeological methods. They should be able to: a) form diagnostic solutions to seismological problems by integrating fundamental sections of seismological Sciences and specialized knowledge; b) be able to independently conduct scientific and methodological work and research in seismology, summarize and analyze experimental information, draw conclusions, formulate conclusions and recommendations;
- skills of conducting independent research and monitoring works; be able to professionally operate modern equipment and devices.

They must:

- to be able to use effective methods of processing and interpretation of complex information to solve problems; to create and research models of the studied objects on the basis of in-depth theoretical and practical knowledge;
- have the communication skills to present their suggestions and recommendations orally and in writing;
- to be able to use effective methods of processing and interpretation of complex information to solve production problems; to build and research models of the studied objects on the basis of in-depth theoretical and practical knowledge;
- critically analyze, present, defend, discuss and disseminate the results of their professional activities;
- to possess skills of drawing up and registration of scientific and technical documentation, scientific reports, reviews, reports and articles;
- to be competent in search and interpretation of technical information using various search engines (patent search, literary review of magazines and books, Internet), in 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;
- to have the ability to perceive diversity and intercultural difference, to appreciate diverse approaches to understanding and solving the problems of society.
- to be able to organize cooperation in a team, to show creativity and breadth of interests to solve interdisciplinary problems.
- to tolerate social, ethnic, confessional and cultural differences, 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 team leader;
- be ready for communication in oral and written forms in Kazakh, Russian and foreign languages to solve the problems of professional activity;
- to support the rules of ethics in society, at work and in interpersonal communication, to 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.

MAJOR CURRICULUM
Educational program 7M05302 - "Seismology"
for 2020-2021 academic year admission

Academic degree: master of technical sciences
Study duration : 2 years

year of study	Code	Name of course	Component	Academic credits	lecture/ laboratory/ practice/MSIW	Prerequisites	Code	Name of course	Component	Academic credits	lecture/ laboratory/ practice/IWS	Prerequisites
	1 semester						**2 semester**					
1	LNG202	Foreign language (professional)	BD IC	6	0/0/3/3		HUM201	History and philosophy of science	BD IC	4	0/0/2/2	
	HUM204	Psychology of management	BD IC	4	1/0/1/2		AAP244	Teaching practice	BD IC	4	1/0/1/2	
	GPH261	Basic seismology	BD IC	6	2/0/1/3		HUM207	Higher school pedagogy	BD IC	4	1/0/1/2	
	GPH286	Geophysical methods for studying the earth's crust	BD OC	6	2/0/1/3		GPH264	Seismic waves in the earth's crust	BD OC	6	2/0/1/3	
	GPH285	The basics of seismotectonics	PS OC	6	2/0/1/3		GPH289	Seismic regime	PS OC	6	2/0/1/3	
	AAP242	Master's student scientific research, including an internship and a master's thesis.	MSSR	6			GPH263	Engineering seismology	PS OC	6	2/0/1/3	
							AAP242	Master's student scientific research, including an internship and a master's thesis.	MSSR	6		
		In total		**34**				**In total**		**36**		
2	**3 semester**						**4 semester**					
	GPH288	Software-processing complexes and technology of computer processing of seismology data	PS OC	6	2/0/1/3		AAP236	Research practice	PS OC	7		
	GPH275	The damage from the earthquake. Methods of assessment of the situation	PS OC	6	2/0/1/3		ECA205	Registration and protection of the master thesis	PS	12		
	GPH287	Physics and prediction of earthquakes	PS OC	6	2/0/1/3							
	GPH267	Seismic monitoring of underground nuclear and industrial explosions. Anthropogenic geophysical phenomena.	PS OC	6	2/0/1/3							
	GPH274	Quantitative seismology	PS OC	6	2/0/1/3							
	AAP242	Master's student scientific research, including an internship and a master's thesis.	НИРМ	6			AAP242	Master's student scientific research, including an internship and a master's thesis.	MSSR	6		
		In total		**36**				**In total**		**25**		
								In all		**131**		

6. Descriptors of the level and scope of knowledge, skills, and competencies

6.1 Based on the achievement of training results in the OP "Seismology", the main framework descriptors of training based on the Dublin descriptors were adopted:

a	Knowledge and understanding – by demonstrating knowledge and understanding in the field of study formed on the basis of secondary education, including certain advanced knowledge in the field of study
в	Application of knowledge and understanding – by applying their knowledge and understanding of actions that indicate a professional approach to the profession through a set of competencies demonstrated through the formation and justification of arguments and solutions to problems in the field of study
c	Expression of judgments and analysis of actions - by accumulating, evaluating, processing and interpreting data, knowledge and skills in order to develop independent judgments based on the analysis of social, ethical and scientific considerations
d	Communication skills and it skills - by transmitting real and virtual information, problems, their solutions, ideas, and their implementations, both to specialists and non-specialists in the field of study
e	Self-learning and existential skills-by developing self-learning and retraining skills with a high degree of autonomy in the field of study and related fields.

6.2 Based on the achievement of training results in the OP "oil And gas and ore Geophysics", the main framework competencies were adopted:

a	Natural-scientific and theoretical-worldview competences
в	Social and personal and civic competencies
c	General engineering professional competencies
d	Communication and it virtual competencies
e	Special professional competencies, including additional (Minor).

6.3 on the basis of training descriptors and basic framework competencies, a framework characteristic of master's competencies has been adopted that guarantees the achievement of a competitive level in the professional activity market.

Based on the specified framework of master's competencies, teachers of the Department of Geophysics form learning results, competencies, subcompetencies and a matrix of competencies of the disciplines that are part of the RUE OP "Seismology" (table).

7. Competencies acquired by undergraduates during the development of the educational program

General cultural competence (GCC) is aimed at forming the basic competence of the individual, ensuring entry into the world cultural space and self-determination in it, mastering the norms of speech etiquette and literary language, as well as the culture of interethnic communication	
GCC -1	Ability to communicate in oral and written forms in the state, Russian and foreign languages to solve problems of interpersonal and intercultural interaction
GCC -2	Understanding and practical use of healthy lifestyle norms, including prevention issues, the ability to use physical culture to optimize performance
GCC -3	Ability to analyze the main stages and patterns of historical development of society for the formation of a civil position
GCC -4	Ability to use the basics of philosophical knowledge to form a worldview
GCC -5	Ability to critically use the methods of modern science in practice
GCC -6	Awareness of the need and acquisition of the ability to independently learn and improve their skills throughout their working life
GCC -7	Meaning and understanding of professional ethical standards, proficiency in professional communication techniques
GCC -8	Ability to work in a team, tolerant of social, ethical, religious and cultural differences
GCC -9	Ability to use the basics of economic knowledge in various fields of activity
General professional competence (GPC) is aimed at developing skills for professional choice and creative use of modern scientific and technical tools for solving scientific and practical problems of seismology	
GPC -1	Ability to independently acquire, comprehend, structure and use new knowledge and skills in professional activities, develop their innovative abilities
GPC -2	Ability to apply in practice knowledge of fundamental and applied sections of seismogeophysical disciplines that determine the direction (profile) of the master's program in seismology
GPC -3	Ability to independently design and carry out research activities in the field of seismology based on the use of modern research methods and information and communication technologies with the use of complex seismological and interdisciplinary research
GPC -4	Understanding the essence and significance of the relationship between theoretical and practical research in seismology, allowing effective and rational study of processes and mechanisms of seismicity; reduce the risks of man-made impact on industrial and civil objects
Professional competence (PC) is aimed at providing deep theoretical knowledge and practical skills in the field of seismology in accordance with the requirements of industry professional standards	
PC 1	Knowledge of perspective directions of development and problems of seismology, modern level of elaboration of problems. Ability to participate in work on innovative projects, set specific seismological tasks and solve them based on the use of modern equipment, software and information technologies using the latest domestic and foreign experience
PC 2	The ability to form diagnostic solutions to professional problems of seismology by integrating fundamental and applied sections of Geophysics (gravimagnetization, geoelectrics, seismology and seismic exploration) and specialized geological and geophysical knowledge (about physical processes occurring in the Earth and the internal structure of the Earth) for the analysis of seismological data and solving problems of seismology

PC 3	Ability to review, analyze and generalize the geological and geophysical information of previous years to select the main parameters of seismological research, conduct experimental and methodological work and optimize the methodology of seismological observations. Creation of a digital database of the original data.
PC 4	Proficiency in professional operation of modern seismological field and laboratory equipment; determination of technical and technological parameters of equipment, equipment, materials and preparation of equipment for field work (setup, verification or testing, preventive maintenance)
PC 5	Ability to prepare initial field seismological data (accounting, quality assessment) for transmission to specialized departments for processing primary information. Organization of digital processing and conversion of primary data into a format that provides final processing and effective interpretation of information from individual seismic stations, registration of processing results and their transfer to the interpretation Department.
PC 6	The ability to compile a database of seismological data of the research area for the development of an earthquake catalog, operational catalogs, and earthquake bulletins. Analysis of seismograms, properties of seismic waves (attenuation) in seismological monitoring. Analysis and modeling of strong motion processes for the development of a consolidated catalog of earthquakes.
PC 7	Skills to develop conclusions about the level of seismic activity and the main morphological and kinematic characteristics of the identified seismic generating structures. Preparation of complex data for building a seismotectonic map, maps of seismic impacts and seismic zoning. Creating a digital archive of reporting data
PC 8	Ability to organize and compile a final report, including the results of seismological observations, processing and comprehensive analysis of the received information.
PC 9	Ability to identify and systematize the main ideas in scientific publications; critically evaluate the effectiveness of various approaches to solving seismological problems; formulate an independent view of the proposed problem taking into account the latest domestic and foreign experience.

7.1 Competence matrix of the educational program 6B07201- " oil And gas and ore Geophysics»

Index discipline`s	Name Disciplines'	General cultural									General-professional				Professional								
		GCC -1	GCC -2	GCC -3	GCC -4	GCC -5	GCC -6	GCC -7	GCC -8	GCC -9	GPC -1	GPC -2	GPC -3	GPC -4	PC -1	PC -2	PC -3	PC -4	PC -5	PC -6	PC -7	PC -8	PC -9
Required component																							
LNG202	Foreign language (professional)	+						+	+														
HUM201	History and philosophy of science	+		+	+	+																	
HUM207	Higher school pedagogy	+				+	+	+	+														
HUM204	Management psychology	+				+	+																
GPH261	The basics of seismology										+	+	+		+	+	+				+	+	
GPH286	Geophysical methods of soil investigation of land											+		+		+	+	+					
GPH264	Seismic waves in the earth's crust										+	+	+		+		+						
Professional component																							
GPH285	The basics of seismotectonics														+	+			+	+			+
GPH289	Seismic regime														+	+	+						+
GPH263	Engineering seismology														+	+	+	+	+	+			
GPH288	Software-processing complexes and technology of computer processing of seismology data										+	+	+	+		+	+	+	+			+	+
GPH275	The damage from earthquakes. Methods for assessing the situation										+		+	+			+	+	+	+		+	
GPH287	Phisics and prediction of earthquakes										+	+		+		+	+	+	+	+	+	+	
GPH267	Seismic monitoring of underground nuclear and industrial explosions. Anthropogenic geophysical phenomena.										+		+		+	+	+						+
GPH274	Quantitative seismology - 1										+		+		+	+	+	+	+	+	+		
State final attestation																							

Index discipline`s	Name Disciplines'	General cultural									General-professional				Professional								
		GCC -1	GCC -2	GCC -3	GCC -4	GCC -5	GCC -6	GCC -7	GCC -8	GCC -9	GPC -1	GPC -2	GPC -3	GPC -4	PC -1	PC -2	PC -3	PC -4	PC -5	PC -6	PC -7	PC -8	PC -9
ECA205	Registration and defense of the master's thesis (RaDMT)																						
Additional types of training																							
AAP244	Pedagogical practice																						
AAP242	Master's student scientific research, including an internship and a master's thesis.																						
AAP236	Research scientific training																						

7.5. Requirements for the research work of the undergraduate

Research work in the scientific and pedagogical magistracy should:

– to correspond to the main problems of the specialty on which the master's thesis is defended;

– to be actual, to contain scientific novelty and practical significance;

– to be based and carried out with the use of modern theoretical, methodological and technological achievements of science and practice;

– contain research (methodological, practical) sections on the main protected provisions;

– based on international best practices in the relevant field of knowledge.

Research work (RW) carried out by a graduate student studying under the master's program "Seismology" has a theoretical, methodological or computational nature. It is performed at the graduate Department of Geophysics under the supervision of a Professor, associate Professor or assistant Professor.

RW may include:

– study of special literature in the field of theoretical and practical seismology;

– collection, processing, analysis and systematization of seismological and geological-geophysical information on the topic of the final qualifying work (dissertation);

– participation in scientific and applied research carried out at the Department of Geophysics, including the use of modern software;

– preparation of separate sections of scientific reports on seismological research carried out at the Department of Geophysics;

– preparation of reports at student, intra-University, regional or international scientific conferences, allowing to assess the level of acquired knowledge, skills and formed competencies of undergraduates.

The volume of research work of the master degree (RWM) is 7 credits (105 academic hours), respectively, 1 credit in the first, second and third semesters and 4 credits - in the fourth semester.

The master's research program is individual and is reflected in his individual work plan.

7.6. Requirements for the organization of practices

The educational program of the scientific and pedagogical magistracy includes two types of practices:

1) pedagogical – at the University;
2) research – at the place of execution of the thesis.

Pedagogical practice

Pedagogical practice is mandatory, since it consolidates the knowledge and skills acquired by undergraduates as a result of mastering theoretical disciplines, develops practical skills and contributes to the complex formation of universal and General professional competencies.

The purpose of pedagogical practice is to study the basics of pedagogical and educational-methodical work in higher educational institutions, mastering the pedagogical skills of conducting certain types of training sessions and preparing teaching materials for the main disciplines of the educational program in the direction of "Seismology".

Basis for teaching practices – Department of Geophysics HNGD KazNAU them.K. I. Satpayev.

The objectives of pedagogical practice are:

– acquisition of teaching experience;

– formation of a holistic view of pedagogical activity, pedagogical systems and structures of higher education;

– development of sustainable 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; study of methods, techniques, technologies of pedagogical activity in higher education;

– development of personal and professional qualities of the teacher.

The volume of pedagogical practice is 1 credit (15 academic hours) in the third semester of the educational program in the direction of "Seismology»

Research practice

The objectives of the research practice are:

– consolidation of skills of scientific or industrial work of undergraduates in the field of seismology;

– obtaining experimental (theoretical, laboratory, field) material for writing a master's thesis;

– the formation of the undergraduate skills and abilities of scientific and technical reports and public presentations;

– organization of practical use of the results of scientific research, including publications, promotion of the results of their own scientific activities;

– formation and maintenance of effective relationships in the team, work in a team.

The objectives of the research practice are:

– ensuring the direct participation of the student in research works on seismology in order to obtain the necessary material to solve the scientific problem or solve practical seismological or geological and geophysical problems;

– acquisition of professional competencies in accordance with the types and tasks of exploration;

– involvement of the undergraduate student in the scientific discussion in the creative team;

– development of public speaking skills;

– development of technical means of presentation of scientific results.

Forms of research practice: field, laboratory, office.

The content of the research practice of a graduate student-geophysicist depends on

the direction (theoretical, practical, etc.), the task and the theme of the master's thesis. It is directly related to the nature and direction of the scientific activities of the organization in which the undergraduate is practicing.

The plan of research practice is made individually for each undergraduate and is a program of theoretical, experimental or field work in the field of seismology.

This plan provides for: collection of geological and geophysical information on the structure of the object of research, seismic and geological-geophysical study of the territory; analysis of seismological and other data of the studied area; formulation and justification of specific research works; conducting field, experimental or computational work; processing and interpretation of the obtained materials.

The volume of research practice is 5 credits (75 academic hours) in the third semester of the educational program in the direction of "oil And gas and ore Geophysics".

8. ECTS diploma Supplement

The application is developed according to the standards of the European Commission, the Council of Europe and UNESCO / CEPES. This document serves only for academic recognition and is not an official confirmation of the document on education. Without a master's degree in "Seismology" it is not valid.

The purpose of filling out the European application is to provide sufficient data on the holder of the diploma, the qualification obtained, the level of this qualification, the content of the training program, the results, the functional purpose of the qualification, as well as information on the national education system. The application model on which the estimates will be translated uses the European transfer or credit transfer system (ECTS).

The European diploma Supplement provides an opportunity to continue education in foreign universities, as well as to confirm the national higher education for foreign employers. When traveling abroad for professional recognition will require additional legalization of the diploma of education. The European diploma Supplement is completed in English on individual request and is issued free of charge.

According to the sectoral framework of qualifications for masters in seismology, geological exploration includes regional and large-scale geophysical and other surveys, various types of prospecting, geological, hydrogeological and engineering-geological works, the implementation of which is carried out within the framework of the Code of the Republic of Kazakhstan "on subsoil and subsoil use" dated December 27, 2017, No. 125-VI SAM (as amended, bill of 24.05.2018 No. 156) and the decree of the Government of the Republic of Kazakhstan dated 13 August 2012 No. 1042 "On the concept of geological sector development of Kazakhstan till 2030".

The sequence of work on the implementation of this mission involves the preparation of materials and equipment, design, conducting field and field seismic and geophysical work, as well as in-house processing and registration of the results of complex and specialized seismological and geological-geophysical studies, which require the involvement of seismologists at level 7.

Master of seismology-level 7 industry qualifications framework (IQF)

Knowledge – conceptual professional and/or scientific knowledge (including

innovative) and experience in seismology and/or at the intersection of specialties. Assessment and selection of professional information on seismic and geophysical methods. Creation of new theoretical and applied knowledge in the field of seismology. Identification of sources and search for information necessary for the development of activities.

Skills – solving problems of technological or methodological nature in seismology, requiring the development of new approaches, the use of a variety of methods (including innovative). Correction of activity of division or organization. Ability and skills to scientifically justify the setting of goals and the choice of methods and means to achieve them.

Personal and professional competences

Independence: setting the tasks of both complex and specialized seismogeophysical studies, ensuring the choice of methods and techniques for conducting these studies, their qualitative implementation and obtaining specific results.

Responsibility: for the planning, development and results of the activity process that may lead to significant changes or development. Responsibility for personnel safety, labor and environmental protection.

Complexity: activities involving the solution of development problems, the development of new approaches in seismology, the use of a variety of seismogeophysical methods.

Ways to achieve the qualification of the appropriate sublevel - master's degree and practical experience.

Recommended job titles – senior or senior researcher.

SATBAYEV UNIVERSITY

Satbayev Kazakh National Research Technical Uniuversity
Қ.И.Сәтбаев атындағы Қазақ Ұлттық техникалық университеті

DIPLOMA SUPPLEMENT

_____

This Diploma Supplement follows the model developed by the European Commission, Council of Europe and UNESCO/CEPES. The purpose of this supplement is to provide sufficient independent data to improve the international 'transparency' and fair academic and professional recognition of qualifications (diplomas, degrees, certificates, etc.) It is designed to provide a description of the nature, level, context, content and status of the studies that were pursued and successfully completed by the individual named on the original qualification to which this supplement is appended. It should be free of any value - judgements, equivalence statements or suggestions about recognition. Information should be provided in all eight sections. Where information is not provided, a reason should be given.

1	INFORMATION IDENTIFYING THE HOLDER OF THE QUALIFICATION	
1.1	Family Name	
1.2	Given Name	
1.3	Date of Birth (Day/Month/Year)	
1.4	Graduate Student Identification Number	
2.	INFORMATION IDENTIFYING QUALIFICATION	
2.1	Title of Qualification and the Title Conferred	Master degree in Seismology. Level 7
2.2	Major	«Seismology»
2.4	Name and Status of Awarding University in original language	Қ.И.Сәтбаев атындағы Қазақ Ұлттық техникалық зерттеу университеті
2.5	Name and Status of Awarding University in English	Satbayev Kazakh National Research Technical Uniuversity
2.6	Language of Instruction	
3	INFORMATION ON THE LEVEL OF THE QUALIFICATION	
3.1	Level of Qualification	Master degree’s level/ second-cycle degree of higher education
3.2	Official Length of Program	2 years
3.3	Access Requirements	
4	INFORMATION ON THE CONTENTS AND RESULTS GAINED	
4.1	Mode of Study	Full-Time

<table>
<tr><td>4.2</td><td>Program Requirements</td><td colspan="4">The total credits for theoretical education are 59, including 20 credits for basic disciplines, 22 credits for major disciplines, and 17 credits for additional types of education.</td></tr>
<tr><td>4.3</td><td>Program Details</td><td colspan="4">Attached in transcript of records</td></tr>
<tr><td>4.4</td><td>Grading Scheme</td><td colspan="4"><table>
<tr><th>Evaluation</th><th>GPA</th><th>Point %</th><th>Appreciation</th></tr>
<tr><td>A</td><td>4</td><td>95-100</td><td>"Excellence"</td></tr>
<tr><td>A-</td><td>3,67</td><td>90-94</td><td>"Excellence"</td></tr>
<tr><td>B+</td><td>3,33</td><td>85-89</td><td>"Good"</td></tr>
<tr><td>B</td><td>3</td><td>80-84</td><td>"Good"</td></tr>
<tr><td>B-</td><td>2,67</td><td>75-79</td><td>"Good"</td></tr>
<tr><td>C+</td><td>2,33</td><td>70-74</td><td>"Pass"</td></tr>
<tr><td>C</td><td>2</td><td>65-69</td><td>"Pass"</td></tr>
<tr><td>C-</td><td>1,67</td><td>60-64</td><td>"Pass"</td></tr>
<tr><td>D+</td><td>1,33</td><td>55-59</td><td>"Pass"</td></tr>
<tr><td>D</td><td>1</td><td>50-54</td><td>"Pass"</td></tr>
</table></td></tr>
<tr><td>5</td><td colspan="5">INFORMATION ON THE FUNCTION OF THE QUALIFICATION</td></tr>
<tr><td>5.1</td><td>Access to Further Study</td><td colspan="4">Eligible for second-cycle higher education, graduate programs in master</td></tr>
<tr><td>5.2</td><td>Professional Status</td><td colspan="4">Under legislation of the Republic of Kazakhstan, a person who was taken Master Degree in Seismology is qualified for posts or positions in the industrial, public and scientific sectors for which the qualification requirement is a first higher education degree in major study. In some cases, the qualification requirement also includes the completion of studies in certain specified fields of minor study.

The degree is also satisfied and corresponded to the Article 11 of the Directive of the European Parliament on the recognition of professional qualifications under level D of The European Union.</td></tr>
<tr><td>6</td><td colspan="5">ADDITIONAL INFORMATION</td></tr>
<tr><td>6.1</td><td>University Address</td><td colspan="4">22 Satpayev Street, Almaty, 050013, Kazakhstan allnt@ntu.kz
www.satbayev.university</td></tr>
<tr><td>6.2</td><td>Further information source</td><td colspan="4">http://edu.gov.kz/ru</td></tr>
<tr><td>7</td><td colspan="5">CERTIFICATION OF THE SUPPLEMENT</td></tr>
<tr><td>7.1</td><td>Place and Date</td><td colspan="4">“___’ _____ 201__ Almaty, Kazakhstan</td></tr>
<tr><td>8</td><td colspan="5">INFORMATION ON THE NATIONAL HIGHER EDUCATION SYSTEM</td></tr>
<tr><td colspan="6">The education system of the Republic of Kazakhstan consists of basic secondary education, general upper secondary education, vocational upper secondary education, higher education and graduate education. The basic education consists of a 9-year compulsory school for all children from 6 to 15 years of age.
Post-compulsory education is given by general upper secondary schools for 2 or 3 years and vocational upper-secondary institutions. The general upper secondary school provides a 2- or 3-years, at the end of which the pupil takes the Unite National Test (UNT) examination for 2-year study and the Matriculation examination for 3-year study. Vocational institutions provide 3-year programs, which lead to upper</td></tr>
</table>

secondary vocational qualifications with further the Complex Test Attestation (CTA). General eligibility for higher education is given by the UNT for a 4-year study, the Matriculation examination or the upper secondary vocational qualification with gained CTA results for a 3-year higher education. Higher education studies are measured in credits. Study courses are qualified according to the workload required. One year of studies is equivalent to 1600 hours of student work on the average and is defined as 36 National credits or 60 ECTS credits. The credit system after recalculation complies fully with the European Credit Transfer and Accumulation System (ECTS).		
8.1	University Degree	The Government Decree on University Degrees (GOSO/2016) defines the compulsory objectives, extent and overall structure of degrees. The universities decide on the detailed contents, curricula, forms of instruction and structure of the degrees they award.
8.2	Second-Cycle (Master degree)	The second-cycle university degree (Master) consists at least 24 (45 ECTS) credits for 1-year full-time study, 36 (67 ECTS) credits for 1.5-years full-time study or 50 (93 ECTS) credits for 2-years full-time study. The degree is usually called Master in Technics or Master in Business Administration for 1 and 1.5-year full-time study; Master in Science for 2-years full-time study. The admission requirements for the second-cycle university degree (graduate) is a first-cycle university degree (undergraduate). General eligibility for the second-cycle education is given by a combination grade of the National Test of English Language unless an applicant has IELTS test results certified 6.0 overall and the Proficiency Examination, which is corresponding to GRE Subject Examination. Studies forwarding to the second-cycle university degree (Master) provide graduate with: (1) profound knowledge of the major subject or a corresponding entity and conversance with the fundamentals of the advanced studies in the field; (2) advanced knowledge and research skills needed to apply scientific knowledge and research approaches required for independent and demanding experimental work (dissertation); (3) good overall knowledge and professional skills in major field needed for operating as an expert and developer of the field; (4) scientific knowledge and interests needed for scientific (Doctoral) or postgraduate education devoted to cutting-edge science; (5) fluent professional English, communication and oral skills. Studies forwarding to degree include at least Intermediate Studies – 8 (15 ECTS) credits and Advanced Studies – 16 (30 ECTS) credits. Additionally, Internship improving expertise – 6 (11 ECTS) credits, a Final Dissertation Work – 6 (11 ECTS) credits.

FOREIGN LANGUGAGE (PROFESSIONAL)

CODE - LNG202
ACADEMIC CREDITS – 6 (0/0/3/3)
PREREQUISITES - no

PURPOSE AND OBJECTIVES OF THE COURSE

The purpose of teaching a foreign language as a General subject of social and humanitarian block in the universities of the above areas is to form the communicative and professional competencies of undergraduates. Linguistic (language), discursive (speech) and socio-cultural competences are formed as part of communicative competence on an integrative basis.

The content of linguistic competence includes knowledge and ability to apply in communicative and professional activities phonological, lexical, grammatical phenomena of the studied language to a certain extent.

BRIEF DESCRIPTION OF THE COURSE

The course is designed for undergraduates to enhance their language competence in their respective professional fields. To teach doctoral students to work with texts in the specialty both audio and written.

The course is focused on mastering the basic and core competencies that allow you to acquire knowledge on your own. Therefore, in addition to the development of knowledge, it is important to acquire skills with which you can receive, process and use new information.

The curriculum is built on the necessary vocabulary (words and terms) often used in English for special purposes. Doctoral students will acquire professional English skills through integrated content-and language-based learning, acquire the vocabulary to read and understand original sources with a high degree of independence, and practice a variety of communication models and vocabulary in specific professional situations.

As a result of mastering the discipline the undergraduate must:

Know:

– terminology in English in seismology and related fields of knowledge;

– grammatical constructions typical for professionally oriented, technical and scientific materials;

– main features of scientific and technical functional style in both English and Russian;

– basic techniques of analytical and synthetic processing of information: semantic analysis of the text by paragraphs, isolation of information units and drawing up a plan of the refereed document in a concise form;

– features of professional etiquette of Western and domestic cultures.

Be able to:

– read in the introductory reading mode, understanding at least 70 % of the text content-500 printed characters per minute;

– read in view reading mode at least 1000 printed. signs per minute;

– read aloud 600 printed characters per minute fluently;

– prepare for 45 minutes the interpretation of the text on the profile of their specialty volume of at least 4-4,5 thousand characters;

– carry out translation of professionally oriented authentic texts of 2000 printed characters in 45 minutes –

– refer professionally-oriented texts and make annotations to them;

– select, process and design literature on a given professional topic for writing an essay;

– prepare and present technical and scientific information used in professional activities in the form of a presentation;

– listen to authentic audio and video materials related to the direction of training.

Possess:

– basic written communication skills necessary for correspondence for professional and scientific purposes;

– skills of performance with the prepared monological message on a profile of the scientific specialty, it is reasoned stating the position and using auxiliary means (tables, schedules, diagrams, etc)

– ability to apply the acquired knowledge in the future professional activity

HISTORY AND PHILOSOPHY OF SCIENCE

CODE - HUM 201
ACADEMIC CREDITS - 4 (1/0/1/2)
PREREQUISITES - no

COURSE PURPOSE

The purpose of teaching the discipline is: the formation of a General scientific, philosophical and methodological, ideological and disciplinary-theoretical basis for scientific and scientific-pedagogical activities of future specialists, scientists, teachers.

PURPOSE AND OBJECTIVES OF THE COURSE

The objectives of the study of this discipline are as follows:

– understanding the dynamics of science, its impact on the development of society, the formation of a holistic image of science, awareness of various aspects and contexts of the study of science itself;

– development of relations of science and various sections of philosophical knowledge, expansion and deepening of philosophical problems of separate special scientific disciplines;

– understanding the methodological foundations and problems of modern science, mastering the theory of method as a special teaching on the principles, approaches, techniques, methods of scientific activity, mastering the logic and methodology of science, development of methodological culture of research work.

BRIEF DESCRIPTION OF THE COURSE

Philosophy of science is a necessary condition for the development of relations between science and various sections of philosophical knowledge, expansion and deepening of philosophical problems of certain special scientific disciplines. Philosophical knowledge not only stimulates the development of science, but also organically enters into science as an integral part of scientific knowledge. The philosophy of science acts as the self-consciousness of science in its socio-cultural manifestations, science is comprehended in the context of the spiritual development of society, the value orientations of the development of scientific knowledge, the practice of research activities are formed. The philosophy of science allows us to reveal the foundations of science as a social institution, a powerful productive force, a system of scientific knowledge that forms public consciousness. This knowledge forms the space in which the scientific and pedagogical activity of the future specialist will take place.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline the master should:

Know:

The main concepts of modern philosophy of science, the main stages of the evolution of science, the functions and foundations of the scientific picture of the world.

Be able to:

Use positions and categories of philosophy of science for the analysis and an estimation of the various facts and the phenomena.

Possess:

– skills of analysis of the main ideological and methodological problems, including interdisciplinary nature, arising in science at the present stage of its development;

– technologies of planning in professional activity in the sphere of scientific researches.

HIGHER SCHOOL PEDAGOGY
CODE-HUM 207
ACADEMIC CREDITS - 4 (1/0/1/2)
PREREQUISITES – no

COURSE OBJECTIVE

Purpose of the discipline: it consists in forming the foundations of pedagogical culture as the basic basis for further successful mastering of scientific and pedagogical knowledge, skills and values in the field of pedagogical science and practice by undergraduates.

COURSE OBJECTIVE

A specialist with a postgraduate education, focused on future research and teaching activities, should be able to build and manage the pedagogical process, work in a group and with a group, build individual, didactically correct training and education.

BRIEF DESCRIPTION OF THE COURSE

This course aims to provide undergraduates with knowledge of the theory and methodology of teaching in higher education, systematize ideas about the specifics of pedagogical activity, master knowledge about the organization of the educational process and its management, the features of individual mental development and personality formation.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline, the master must:

Know:

- specifics of various areas of psychological and pedagogical activity: diagnostics, correction and development, teaching (education), prevention;
- methodological basis for the development and planning of psychological and pedagogical classes;
- functional and organizational and legal bases of professional activity of a psychologist depending on the type of institution.

Be able to:

- make psychological and pedagogical characteristics of both the individual and the team on the basis of the study;
- use psychological methods of development and education of students taking into account their age and individual characteristics;
- organize extracurricular psychological and pedagogical activities aimed at personal development, optimizing the psychological climate of the team, supporting the educational process, self-determination and professional orientation.

Possess the following skills:

- planning of psychological and pedagogical activities (preparation of training programs, event plans, correctional and developmental programs);

- psychological and pedagogical communication both individually and with the audience, taking into account age, social, etc. features;
- joint project execution in a team of colleagues;
- methods of active social and psychological training (discussion, brainstorming, problem lecture, etc.);
- individual psychological methods to increase the motivational potential of students.

MANAGEMENT PSYCHOLOGY

CODE-HUM 204
ACADEMIC CREDITS - 4 (1/0/1/2)
PREREQUISITES –no

COURSE OBJECTIVE

The goal is to familiarize students with modern concepts of the role and multidimensional content of the psychological component of management activities; to improve the psychological culture of the future master for the successful implementation of professional activities and self-improvement.

COURSE OBJECTIVE

- Study of theoretical and methodological foundations of management psychology-familiarity with various concepts, basic concepts, laws of management psychology.
- Study of the main socio-psychological problems of management and ways to solve them.
- Formation of the undergraduates ' attitude to the mandatory consideration of individual and group psychology in management activities.
- Familiarization with the methods of studying important socio-psychological characteristics of the individual and team, professional, interpersonal and intrapersonal problems by means of management psychology.
- Learning the basics of Executive psychology.

BRIEF DESCRIPTION OF THE COURSE

This course aims to familiarize undergraduates with the resource capabilities of the human factor in the management of organizations in modern conditions. The discipline is designed to consider the psychological characteristics of management objects, both personnel and the organization as a whole, and management subjects, which are managers of different levels. The discipline reveals the psychological mechanisms that ensure the effectiveness of management systems, describes modern psychological technologies and approaches to solving management problems.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline, the master must:

Know:

- the importance of management psychology in establishing mutual understanding and forming interpersonal relationships in the professional environment,

- the importance of the psychologist's activity in the use of tools and methods of management psychology in professional activities,

- the importance of factors that influence the formation, development and strengthening of management psychology in professional activities.

Be able to:

- determine the characteristics of management psychology in professional activities,
- to implement activities for the development of the strategy and tactics of management psychology.

THE BASICS OF SEISMOLOGY

COD – GPH261
ACADEMIC CREDITS - 6 (2/0/1/3)
PREREQUISITES – PHY 112

COURSE PURPOSE

Undergraduates receive knowledge and modern ideas about:

- earthquakes and related phenomena, the nature and basic laws of seismicity of the Earth and the seismic regime of its various regions;
- types of earthquakes and their causes; seismic waves excited by earthquakes and recorded at seismic stations;
- models of the earthquake center and physics of its preparation processes;
- theories and methods of studying the internal structure of the Earth using seismic waves, principles and methods of seismic hazard assessment, seismic zoning and earthquake prediction;
- time of occurrence and propagation of dynamic effects from earthquakes.

COURSE OBJECTIVES

- familiarity with the history of seismology; from descriptive to modern; with a complex system of instrumental observations;
- study of a wide range of information geological-tectonic, geophysical, hydrochemical, biological and other content in order to learn the laws of localization of foci of strong earthquakes;
- acquisition of knowledge on hardware equipment of seismic stations and processing of the received seismological material;
- familiarization with the existing scales (macroseismic and instrumental); with the features of the macroseismic scale and the methodology for assessing the intensity of concussion on the earth's surface; with approaches and methods for assessing seismic hazard and earthquake forecasting;
- the study of microseisms and their causes, perceptions about the seismic tremors that accompany strong earthquakes (foreshocks, aftershocks, etc.); effects of strong earthquakes.

BRIEF DESCRIPTION OF THE COURSE

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 applications to wave theory, rheology, and the foundations of the theory of fracture of materials. The course allows undergraduates to master modern methods of describing the mechanical properties of materials, the technique of solving dynamic problems of mechanics of elastic-viscous media, to get an idea about the physics of fracture and the theory of strength of heterogeneous materials. The content of the special course: elements of tensor analysis, deformation and stress in a continuous medium, equations of motion, elasticity, equations of motion of an elastic medium, elastic waves, elementary

rheological bodies, linear rheological bodies, nature of viscosity of solids, fundamentals of physics of strength and fracture of materials.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline undergraduates should

Know:

Modern physical representations underlying modern structural and focal seismology;

Be able to:

- apply the methods of continuum mechanics in the problems of seismic wave propagation and rock destruction;
- identify types of earthquakes; seismic waves excited by earthquakes;
- use seismic and geophysical equipment;
- use the methodology of seismic hazard assessment, intensity of tremors on the earth's surface and earthquake forecasting.

Possess skills of:

- modern methods of description of mechanical properties of materials, technique of solving dynamic problems of mechanics of elastic-viscous media;
- using methods of seismic hazard assessment and earthquake forecasting.

THE BASICS OF SEISMOTECTONICS
COD – GPH285
ACADEMIC CREDITS - 6 (2/0/1/3)
PREREQUISITES – PHY 112

COURSE PURPOSE

The purpose of the discipline "Seismotectonics" is to familiarize undergraduates with the basic information about the nature of seismicity, both globally and regionally, as well as with the characteristics of geological structures that generate earthquakes.

COURSE OBJECTIVES

- to present fundamental and applied components of seismotectonics as a science;
- show the features of geological structures that generate earthquakes;
- describe the main methods and techniques of seismotectonic studies;
- to give information about the characteristics of earthquakes and their generating forces in the bowels of the Earth;
- to discuss the features of the distribution of seismic zones in the territories of the world and Kazakhstan.

BRIEF DESCRIPTION OF THE COURSE

Introductory. Subject, purpose and objectives of the course, methods and terms used in seismotectonics. The basic physical, geological and macroseismic characteristics of the earthquake. Structure and manifestations of foci of strong seismic events. Types of seismic dislocations. Methods of estimation of force and time of occurrence of earthquakes on the basis of the analysis of modern and ancient geological and macroseismic manifestations.

Seismogenerating structures: active faults, young folds and mobile blocks of the earth's crust. Use them for seismic hazard assessment. Types and directions of seismic hazard assessment: General, detailed seismic zoning, seismic micro-zoning. Types of earthquake prediction: long-term, medium-term and short-term. Methods and techniques of forecasting. Successes and failures.

Regional seismotectonics. Seismogenic structures and the most important earthquakes of the East and South-East of Kazakhstan. Main achievements and prospects of development of seismotectonics as a science.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline undergraduates should

Know:

- patterns of distribution of earthquakes on continents and oceans, on the boundaries of lithospheric plates and in intraplate geodynamic conditions;

- list and structure of geological structures: active faults, disjunctive nodes, fold-discontinuous and Flexural-discontinuous zones, blocks of the earth's crust, to which the foci of earthquakes are confined;

- characteristics of geological, seismological and geophysical manifestations of the strongest, most important in terms of damage and best studied earthquakes that occurred in different regions of the world and, in particular, on the territory of our country;

- principles of seismic hazard assessment, General and detailed seismic zoning, seismic micro-zoning;

- current state of the problem of earthquake forecasting.

Be able to:

Independently or in a team to conduct seismotectonic and paleoseismogeological studies, to make scientific and applied conclusions, to participate in the preparation of scientific reports.

Possess skills of:

the main methods and techniques of seismotectonic studies.

SEISMIC WAVES IN THE EARTH'S CRUST
COD – GPH264
ACADEMIC CREDITS - 6 (2/0/1/3)
PREREQUISITE – PHY 112

COURSE PURPOSE

Acquisition of modern 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 areas, modern models of physics of the earthquake.

COURSE OBJECTIVES

- to create conditions for mastering by undergraduates the basic concepts of the discipline "Seismic waves in the earth's crust" through familiarity with the concept of seismic waves and seismic studies;
- formation of basic knowledge about modern seismological methods of studying the internal structure of the Earth, 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 construction of spatial kinematic and dynamic models of the structure of the Earth as a whole and;
- training in modern methods of solving inverse problems in seismology, principles of planning seismological monitoring and primary data processing.

BRIEF DESCRIPTION OF THE COURSE

Development of instrumental observations. Seismological observation systems. Sources of seismic oscillations. Seismic waves, their main characteristics, the speed of seismic waves. Beam theory of seismic wave propagation. The concept of physical and mathematical ray. Seismic rays, the ray parameter, wave fronts. Properties of seismic rays. Basic algorithms for calculating seismic ray paths.

Inverse kinematic problem. Equation Herglotz-Wiechert. Ray trajectories and hodographs for a homogeneous layer lying on a half-space. Inverse kinematic problem for sections involving low-velocity layers. Inverse problem in reflected wave seismics.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline the undergraduate must:

Know:

- fundamental laws of radiation and propagation of seismic waves in the Earth, theories and methods of studying the internal structure of the Earth using 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;
- basic algorithms for solving inverse problems of seismology;
- current trends in the study of the internal structure of the Earth and the basis of seismic monitoring.

Be able to:

- plan experiments to study the deep structure of the Earth by seismic methods, process and interpret the data obtained;
- determine the parameters of earthquake foci from seismic records and macroseismic manifestations, to plan and carry out work on General, detailed and microseismic zoning;
- use the acquired knowledge to build spatial models of seismic wave velocity distribution for the studied territories;
- build initial velocity models in accordance with experimental data and available a priori information;
- carry out geological and geophysical interpretation of the received models, to compare the received results with earlier made conclusions on other geophysical fields;
- evaluate the reliability and accuracy of the results.

Possess:

- skills of independent work;
- skills of analysis of seismic records, allocation of seismic events and introductions of separate seismic waves;
- the basics of setting and solving problems of seismic monitoring;
- practice of research and solution of theoretical and applied problems.

ENGINEERING SEISMOLOGY

CODE – GPH263
ACADEMIC CREDITS - 6 (2/0/1/3)
PREREQUISITES – PHY112

COURSE PURPOSE

- study of seismic data required for the design of stable (earthquake-resistant) structures during earthquakes;
- assessment of engineering and seismological conditions of the studied territory.

COURSE OBJECTIVES

- identification of earthquake-prone areas and preliminary forecasts of the likely seismic impact of a strong earthquake;
- determination of the location of foci of probable earthquakes, the strength of earthquakes on the earth's surface, the recurrence of earthquakes, the likely parameters of seismic impact to assess areas of seismic hazard.

BRIEF DESCRIPTION OF THE COURSE

Introduction. Fundamentals of engineering seismology. Assessment of the strength of earthquakes. Intensity of earthquakes. Seismic zoning and micro-zoning.

Types of seismic zoning (General seismic zoning, detailed seismic zoning, seismic micro-zoning) content, methods, scale and completeness of the study. Seismic impact is characterized by points on the seismic grid or amplitudes of oscillations recorded by special devices.

Engineering analysis of earthquake consequences. Analysis of consequences and methods of protection against earthquakes, methods of ensuring seismic safety of the population and territories.

Practical method of calculation for seismic effects. Design of earthquake-resistant buildings. Special seismic protection systems.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline undergraduates should

Know:

- theoretical foundations, basic concepts of engineering seismology and its terminology;
- causes, mechanism, patterns of occurrence and main characteristics of earthquakes, as well as their consequences for the main structural systems and solutions of industrial and civil construction;
- principles of seismic hazard assessment, General and detailed seismic zoning, seismic micro-zoning for solving problems of earthquake-resistant construction;
- reference and regulatory apparatus for the selection of materials, design solutions and technologies that ensure the performance, reliability, durability of buildings and structures in seismically active regions;

Be able to:

- navigate through the maps of seismic zoning and to collect seismic data for seismic hazard assessment;

- to determine the background score of cities and settlements and to specify the calculated score depending on the specific ground conditions of the construction site;

Possess skills of:

- work with normative literature, possess special concepts and terms;

- quantitative assessment of earthquake strength by magnitude and qualitative assessment of the intensity of earthquakes on the surface in seismic scores and characteristics of soil vibrations.

SEISMIC REGIME

COD – GPH289
ACADEMIC CREDITS - 6 (2/0/1/3)
PREREQUISITES – GPH113

COURSE PURPOSE

Knowledge and understanding by undergraduates:

- theoretical bases and regularities of distribution of the aggregate of earthquake foci of a particular region in time, space and energy;
- a quantitative measure of the parameters of the seismic regime, determined by the average number of earthquake foci in a certain range of energy values in the vicinity of the point in question, in a unit of space (volume, area) and in a unit of time.
- seismic situation of areas within the seismic region;

COURSE OBJECTIVES

- study of the seismic regime as a scientific direction, goals and objectives, subject and object of research;
- analysis of the main parameters of earthquake foci and methods of their assessment by macroseismic and instrumental data;
- determination of: a) the essence of the main parameters of the seismic regime, methods of their calculations and constructions; b) existing approaches and methods for assessing the recurrence of strong earthquakes in certain areas; C) the seismological basis for assessing the seismic hazard.
- to give an idea of the main models of the seismic regime;
- to give an idea of the catalogue of earthquakes and of the assessment of their representativeness in various ways; of the different types of sequences of earthquakes and the mechanisms of their formation;
- description of existing approaches and methods of calculation and construction of maps of seismic activity, density of epicenters, angle of inclination of the recurrence graph, the maximum possible earthquake, mechanisms of foci, etc.

BRIEF DESCRIPTION OF THE COURSE

The course "Seismic regime" studies the patterns of distribution of a set of earthquake foci of a particular area (region), considered in time, space and energy; the essence of the main parameters of the seismic regime, the methodology of their calculations and constructions; approaches and methods of calculations and construction of maps of seismic activity, density of epicenters, angle of inclination of the recurrence graph, the maximum possible earthquake, mechanisms of foci, etc.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline students should

Know:

- statistical regularities of seismic regime in energy, time and geometric domains;
- law Gutenberg-Richter law and the hierarchy of Sade;

- fractal geometry of seismicity, temporal grouping of earthquakes,
- seismic cycle and the frequency of occurrence of earthquakes.

Be able to:

- investigate the seismic situation of a vast territory within the seismically active region; to determine the quantitative values of the parameters of the seismic regime;
- carry out statistical calculations of earthquake parameters, to use modern software tools for seismic regime analysis, to build a mathematical model of seismicity.

Possess skills of:

- assessment of the seismic situation within the seismic region;
- determination of quantitative values of seismic regime parameters;
- work with seismological equipment;
- freely and creatively use modern methods of analysis, processing and interpretation of complex seismogeophysical information to solve scientific and practical problems of seismology.

THE DAMAGE FROM THE EARTHQUAKE. METHODS OF ASSESSMENT OF THE SITUATION

CODE-GPH275
ACADEMIC CREDITS - 6 (2/0/1/3)
PREREQUISITE- GPH113

COURSE PURPOSES

Obtaining the necessary knowledge by undergraduates on:

- determination of the volume, nature and degree of destruction of objects and their elements (emergency zone);
- calculation of necessary forces and means for carrying out rescue and other urgent works (as and DNR), i.e. liquidation of consequences of 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 conduct of the AU and the DPR.

COURSE OBJECTIVES

- mastering by undergraduates of the basic concepts of the discipline "damage from earthquakes; methods of assessment of the situation" through familiarization with historical and modern seismic data;
- mastering the skills of calculating the consequences of an earthquake;
- mastering the skills of calculating damage to administrative structures and residential buildings after earthquakes;
- development of classification of buildings and administrative structures;
- calculations of engineering and economic consequences of the earthquake;
- calculations of demographic consequences of the earthquake;
- calculations of the political consequences of the earthquake.

BRIEF DESCRIPTION OF THE COURSE

Scientific and methodical bases of calculation of damage from an earthquake and its consequences. Classification of buildings and structures. Calculation of the degree of damage to buildings and structures on the seismic scale MSK-64. Prediction of the loss of population in densely populated cities. Prediction of damage and destruction of buildings. Calculation of strengthening of administrative structures: kindergartens, schools, hospitals, etc. Calculation of equipment and special medicines for rescue operations after earthquake damage. Calculation of the organization of financing for restoration works. Psychological effects of earthquake damage.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline the undergraduate must
Know:

- bases of calculation of damage of damages of buildings and constructions after earthquakes;
- have an idea of calculating the degree of damage on the MSK-64 scale;
- assessment of damage in the demographic calculation;
- the basic steps of rescue operations after the devastating earthquake;
- assessment methods in the socio-economic, political and demographic consequences of earthquakes.

Be able to:

- process and interpret the information received on the degree of destruction of industrial and civil construction;
- calculate the maximum intensity in the earthquake center;
- apply and explain the rules of conduct during an earthquake;
- make a program of preparation of consequences during earthquakes;
- assess the degree of damage on the MSK-64 scale;
- predict the degree of destruction in densely populated areas on the MSK-64 scale;
- to assess the reliability and accuracy of the results.

Possess:

- skills of independent work;
- skills analysis calculation and evaluation on the MSK-64 scale;
- bases of statement and the decision of tasks on liquidation of consequences of earthquakes and calculation of damage to buildings and constructions;
- practice of research and solution of theoretical and applied problems.

PHYSICS AND PREDICTION OF EARTHQUAKES

CODE-GPH287
ACADEMIC CREDITS - 6 (2/0/1/3)
PREREQUISITE - PHY112

COURSE PURPOSES

- to acquaint undergraduates with modern physical concepts of the earthquake preparation process;
- to discuss the main problems of scientific research in the field of forecasting, to determine the place of these problems in the physical picture of the earthquake preparation process;
- to consider the bases of the most perspective directions in the solution of a problem of the forecast of earthquakes, mountain shocks and other catastrophic phenomena of the similar nature.

COURSE OBJECTIVES

To acquaint undergraduates with modern physical concepts of the earthquake preparation process and the main problems of scientific research in the field of forecasting; to determine the place of these problems in the physical picture of the earthquake preparation process; to consider the bases of the most promising directions in solving the problem of forecasting earthquakes, mountain shocks and other catastrophic phenomena of a similar nature.

BRIEF DESCRIPTION OF THE COURSE

Earthquake prediction. Goals and objectives of the forecast. The physical background of earthquake prediction. Laboratory studies of the gap formation process. Analogy of experiments and field observations. Types of earthquake prediction. Models and processes of earthquake preparation. Stages of preparation of earthquakes.

Harbingers of earthquakes. The types of precursors. Methods and algorithms of earthquake prediction. Analysis of complex prognostic parameters. Impact on the seismic process. Examples of successful forecasts and existing difficulties. Socio-economic problems of the forecast. Hardware support of forecast works. Organization of prognostic polygons and processing centers. Structure and strategy of forecast works.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline undergraduates should
Know:

- physical parameters of the earthquake; energy, geometric and dynamic characteristics of the earthquake center. Measurement problem, error and uncertainty of estimates;
- the concept of earthquake focus and seismic source model.
- statistical regularities of seismic regime in energy, geometric and time domains.
- cycle and the frequency of occurrence of earthquakes. The problem of comparing the results of seismic statistics with the conclusions of physical theories of destruction. Large-

scale effect, its physical and methodological reasons. Problems of laboratory modeling of seismic process.

Be able to:

- build models of preparation of earthquakes: consolidation model, model of phase transformations; dilatant-diffuse model; model of avalanche-unstable crack formation (LNT).

- identify and identify the advantages and disadvantages of the LNT model, including rock friction, rheology and physical laws of friction, physical conditions of unstable slippage (stick-slip) and the possibility of their implementation in The earth's lithosphere.

- establish the kinetic factors inherent in models of preparation of earthquakes.

Possess:

- approaches to solving the problem of earthquake prediction (physics of earthquake preparation and the necessary phases of prediction algorithms: long-term, medium - term and short-term forecasts);

- concepts of precursors. Seismic harbingers (breaches, lulls and foreshocks, migration of earthquakes, variations in the slope of the recurrence graph, the concentration of seismogenic breaks, etc.). Deformation precursors (regularities of manifestation and theoretical estimates). Complex of electromagnetic precursors (variations of electrical resistance, electrotelluric field, electromagnetic radiation, geomagnetic field, ionospheric anomalies, etc.). Geochemical and other precursors.

- General regularities of the manifestation of geophysical precursors (mosaic manifestations, strain sensitivity, parametric nature of excitation). Statistical regularities of the relationship between the parameters of the harbinger with the parameters of the hearth of the future (preparing) earthquake, their nature.

GEOPHYSICAL METHODS OF SOIL INVESTIGATION OF LAND
CODE-GPH 286
ACADEMIC CREDITS - 6 (2/0/1/3)
PREREQUISITE -PHY112

COURSE GOAL

give undergraduates practical and operational and theoretical information knowledge on:

- deep structure and dynamics of the lithosphere-setting and content of tasks, a set of geophysical research methods, principles of interpretation and basic geological results.
- geodynamic and geostatic models of the lithosphere and plate tectonics;
- tectonic zoning of the Foundation, platforms and orogenic areas;
- prediction of the internal structure of strain-stress zones.

COURSE OBJECTIVE

A study of undergraduates:

- physical and mathematical foundations of geophysical methods, methods of field work; approaches to solving direct and inverse problems: techniques for qualitative geological and quantitative interpretation of geological and geophysical data;
- study of the form of occurrence of rocks in the earth's crust;
- study of the composition, structure and condition of rocks composing the earth's crust, as well as their dynamics,
- methods of compiling and reading geological, tectonic and structural maps,
- construction of geological sections and block diagrams, stratigraphic columns.

BRIEF DESCRIPTION OF THE COURSE

The discipline "Geophysical methods of research of the earth's crust" studies the physical and mathematical foundations of geophysical methods, techniques for quantitative and qualitative geological interpretation of geophysical fields, electric, gravitational, magnetic, seismic and geothermal exploration; principles of integration of geophysical, geochemical and geological methods for studying the subsurface; regional, deep, structural, search and mapping geophysical research.

Magnetic properties of rocks are considered. Types of magnetization of rocks and ores. Earth's magnetic field: its elements, structure, variations; magnetic anomalies. The principles of paleomagnitnye. Magnetic measurements, types of magnetometers, their comparative characteristics. Methods of gravimetric and magnetic surveys. Satellite magnetic measurements.

Rock density: determining factors and patterns. Density models of the lithosphere; density of the earth's mantle and core. Earth's gravitational field: gravitational potential and its derivatives; normal gravitational field; gravity anomalies, their types, geological meaning; variations of the gravitational field. Gravity measurements: dynamic and static methods of gravimetry, types of instruments, their comparative characteristics, measurements of gravity at sea.

Fundamentals of geological interpretation of gravitational and magnetic anomalies. Solving direct and inverse problems; the problem of incorrect inverse problems. The division of the fields. Estimates of parameters of bodies of simple shape; harmonic

moments; methods for selecting bodies of complex shape. Geological interpretation of the results of interpretation of gravitational and magnetic anomalies.

Electrical properties of rocks. Electrical models of the earth's crust. Electromagnetic fields: constant, harmonic, non-stationary. Classification of methods of electrical prospecting on the field types, measuring circuits, and geological problems. Physical models and principles of interpretation of electrical survey data by sensing and profiling methods. Methods of resistances: vertical and dipole electric sounding, electrophilization: tasks, methods of measurement and interpretation, geological results; logging of resistances. Electromagnetic sounding, their principles, tasks, and geological results.

Elastic properties of rocks. Seismic wave velocities in the lithosphere and velocity models of large blocks of the lithosphere. Problems and methods of seismic exploration, environment models. Seismic waves: time fields and wave hodographs, reflection and refraction, waves in multilayer media, elements of dynamics. Classification of seismic survey methods by wave types, observation systems, and geological tasks.

Seismic survey methods: observation systems; wave excitation and registration; wave selection and correlation; signs of head, refrained and reflected waves; principles of primary processing. Methods of GSS (deep seismic sounding); kmpv-MGOV (correlation method of refracted waves and method of deep reflected waves), tasks, GSS – mogt (deep seismic sounding – method of the General depth point), principles of processing and interpretation, deep sections, some geological results. Principles and possibilities of multi-wave seismic exploration. Problems, observation systems, discrete correlation of reference waves, principles of construction of deep seismic sections, their geological interpretation.

Radioactive and thermal properties of rocks: determining factors and patterns. Radio wave methods: tasks, methods, results. Thermal models of the lithosphere. Relationships between physical properties of rocks and complex physical models of geological objects.

Integration of geophysical methods. Goals and principles of aggregation; physical and geological models of objects; rational complex of geophysical methods; approaches to complex interpretation of geophysical data.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline, the graduate student must:

Know:

- methods of geophysical research used in geological exploration (electric, gravitational, magnetic, seismic, radiometric and geothermal exploration);
- General principles of equipment design;
- methods of conducting field geophysical work;
- areas of application of geophysical methods;
- forms of occurrence of rocks in the earth's crust and patterns of their placement, as well as geological conditions of formation;
- methods for compiling and reading geological, tectonic and structural maps, geological sections and block diagrams, stratigraphic columns;

Be able to:

- solve direct and inverse problems;
- classify geophysical methods according to the solved geological problems;

- understand the basic physical laws underlying geophysical methods, physical and geological conditions, and physical and mathematical theories;
- use General and special computer programs for processing structural and geological information.

Possess the following skills:

- study of morphometry of lithosphere structures;
- development of their classification in connection with the regular distribution and combination in the earth's crust by depth and area;
- competent description of the deep geological structure of the research area.

SEISMIC MONITORING OF UNDERGROUND NUCLEAR AND INDUSTRIAL EXPLOSIONS. ANTHROPOGENIC GEOPHYSICAL PHENOMENA.

CODE-GPH267
ACADEMIC CREDITS - 6 (2/0/1/3)
PREREQUISITE - GPH261

COURSE PURPOSE

The discipline familiarizes students with:

- system of basic scientific knowledge and research methods in the field of seismology of underground nuclear and industrial explosions and seismic safety in the mining industry;
- methodology of seismological monitoring of underground nuclear and industrial explosions; methodology of detection and recognition of underground nuclear and industrial explosions from earthquakes;
- factors determining technogenic seismic effects and possible consequences of strong technogenic earthquakes;
- to give the necessary knowledge about the main elements of technogenic geophysical phenomena and the factors determining them,
- with possible consequences of strong man-made earthquakes.

COURSE OBJECTIVES

- to give the basic concepts of monitoring of underground nuclear and industrial explosions, the subject and objects of research;
- to give an idea of the types of man-made earthquakes; seismic waves excited by earthquakes and recorded at seismic stations;
- to characterize the methodological basis and schematic diagram of the analysis of seismological and seismotectonic materials for the assessment of man-made seismic hazard arising from underground nuclear and industrial explosions;
- to familiarize with the seismic network of the International system for monitoring compliance with the comprehensive nuclear-test-ban Treaty on land, in the atmosphere and in the waters;
- to acquaint with methods of identification of underground nuclear and industrial explosions from different seismic events;
- to show the important role of research on the study of the consequences of strong man-made earthquakes;
- to state the principles of mapping and sections characterizing regional and local seismicity, the method of allocation of seismogenic zones.

BRIEF DESCRIPTION OF THE COURSE

Theoretical bases and applied aspects of seismological monitoring of underground nuclear and industrial explosions; historical instrumental observations. Seismic registration devices. Types of seismic instruments and frequency response of the recorded equipment. Recognition of seismic events from nuclear test sites and industrial explosions. Hodograph

of seismic waves based on the results of registration of signals from underground nuclear test and industrial explosions. Calculation of epicenter distance and absorption field of seismic waves. Recognition algorithms for specific polygons and specific seismic stations.

Basic concepts of technogenic geophysical phenomena, the subject and objects of research discipline. Causes of occurrence and classification of technogenic geophysical phenomena, methodical bases and the basic scheme of the analysis of seismological and seismotectonic materials for an assessment of natural and technogenic seismic danger. The role of research on the prediction and study of the consequences of technogenic geophysical phenomena.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline the undergraduate must:

Know:

- fundamental laws of radiation and propagation of seismic waves in the Earth from underground nuclear and industrial explosions; current trends in the study of the internal structure of the Earth and the basis of seismic monitoring;
- the international monitoring system (IMS) established to monitor compliance with the comprehensive nuclear-test-ban Treaty (CTBT);
- characteristics of the recorded seismic equipment;
- basic algorithms for recognition of underground nuclear and industrial explosions;
- features of natural and geological conditions of Kazakhstan, which predetermine the significant susceptibility of its territory to natural and man-made disasters. Protection of the population, environment and economic facilities from emergencies and the consequences caused by them is considered a priority area of state policy.

Be able to:

- process and interpret the received seismic and geophysical data;
- calculate seismic wave velocities from nuclear test sites and industrial explosions;
- identify the historical seismograms of underground nuclear and industrial explosions;
- use the acquired knowledge to build and compare seismic data;
- compare records of underground nuclear and industrial explosions with different seismic events;
- evaluate the reliability and accuracy of the results.

Possess:

- skills of independent work;
- skills of analysis of seismic records, allocation of seismic events and introductions of separate seismic waves of underground nuclear and industrial explosions;
- the basics of setting and solving problems of seismic monitoring;
- practice of research and solution of theoretical and applied problems;
- the necessary knowledge about the factors determining technogenic geophysical phenomena in oil and gas fields, groundwater and solid minerals. with possible technogenic consequences.

QUANTITATIVE SEISMOLOGY

CODE-GPH274
ACADEMIC CREDITS - 6 (2/0/1/3)
PREREQUISITE - PHY112

COURSE PURPOSE

Acquisition of a complex of knowledge on theoretical study of phenomenology and physics of wave processes in the inner shells of the Earth, connection of seismic wave fields with structural features of the earth's interior, methods of evaluation of characteristics and properties of the substance composing the inner shells of the Earth, dynamic characteristics of seismic phases measured at stations of the world network of seismological observations in the interests of a wide range of fundamental and applied problems of modern Geophysics.

COURSE OBJECTIVES

- study of models of the structure of the Earth;
- study of modern ideas about global and local processes that determine the structural features of the earth's shells;
- study of methods of investigation of the deep structure of the Earth;
- development of modern theoretical concepts of wave propagation in an elastic and inelastic medium;
- mastering practical skills of working with a wide range of seismic data: bulletins, catalogs, wave forms, metadata of seismological agencies, etc.

BRIEF DESCRIPTION OF THE COURSE

The deep structure of the Earth according to seismological data. Propagation of seismic waves in the Earth. Types of seismic waves, their main characteristics. General ideas about the use of seismic waves to study the structure of the Earth. Global and regional seismicity.

Theory of elasticity in seismology. Fundamentals of the dynamic theory of elasticity. Stress and strain tensors. Connection of stresses and strains. Elastic energy. The green's function in the dynamic theory of elasticity. Description of seismic sources. The seismic moment. Seismic moment tensor.

Elastic waves from a point source. Wave field in a boundless homogeneous medium. Beam theory of longitudinal and transverse waves in the far zone. Calculation of epicentral distance for spherically symmetric Earth and other models, as well as adjusted (ellipticity, etc.) calculation of azimuth per source / station. Classification of events according to the epicentral distance.

Reflected and refracted waves at plane boundaries. The coefficients of reflection and refraction. The concept of critical angles; inhomogeneous waves and phase shifts. Static and kinematic corrections. Surface waves, Rayleigh and love waves. Group and phase velocities. Dispersion. The effect of imperfect elasticity and variance of speed. Reflection and refraction of spherical waves. Spherical waves as a superposition of plane and cylindrical waves. Head waves. Anisotropic medium.

Direct problem. Travel time. Hodographs and standard models of the Earth. Methods of studying a spherically symmetric Earth. Properties of hodographs of the main phases of bulk waves. Seismic waves in a three-dimensional inhomogeneous medium. The radial build. Scattering on random inhomogeneities. Representation of methods of calculation of synthetic seismograms.

Inverse problems of seismology. Seismic tomography. Linearized and Monte Carlo methods. Self-oscillations of the Earth.

The types and sources of data: information about the hypocenters and waveforms. Seismic services. Catalogues of earthquakes and their unification. Online and offline sources of wave forms. Classification of earthquakes by the energy of the hearth. Earthquake magnitude. Types of magnitudes and their physical bases. Ratios of magnitude scales. Selecting, receiving and viewing digital data. Formats, format conversion. Frequency and dynamic range of seismic signals. Deconvolution.

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline the undergraduate must:

Know:

- fundamentals of the theory of seismic wave propagation in the Earth;
- types and properties of volume waves and their features when registering on modern seismological equipment;
- bases of description of seismic sources on the basis of dynamic theory of elasticity;
- current models of the Earth on seismological data;
- regularities of propagation and attenuation of seismic waves in real environments; methodology for solving direct and inverse problems; fundamentals of seismic tomography;

Be able to:

- carry out systematization and analysis of the obtained and published data;
- deduce correct regularities on the basis of comparison of results of observations and the theory;
- conduct analysis of the obtained results;
- use their knowledge to determine the basic parameters of structural inhomogeneities of the earth's shells;
- apply standard and modified models of the Earth to solve specific geophysical problems; analyze experimental and observational data;
- assess the reliability and accuracy of the results; to effectively use the available software for the analysis of seismograms.

Possess:

- skills of mastering a large amount of information;
- skills of independent work;
- culture of setting geophysical problems; skills of mass processing of initial data and their comparison with theoretical calculations; basic techniques.

SOFTWARE-PROCESSING COMPLEXES AND TECHNOLOGY OF COMPUTER PROCESSING OF SEISMOLOGY DATE

CODE-GPH288

ACADEMIC CREDITS - 6 (2/0/1/3)

PREREQUISITE - PHY112

COURSE PURPOSE

Acquisition of complex of knowledge on computer processing of seismic data, automation of process of collecting, processing and storage of seismological information.

COURSE OBJECTIVES

- to study the basic concepts of primary processing of seismograms
- learn about earthquake catalogs and their contents
- to develop a computer program for processing seismological data
- mastering practical skills of working with a wide range of seismic data: bulletins, catalogs, wave forms, metadata of seismological agencies, etc.

BRIEF DESCRIPTION OF THE COURSE

With the increase in the network of digital stations, the volume of routine processing of seismological material continues to increase, a fundamentally new approach to improving the existing seismic service and creating new optimal and authorized systems for the production, collection, processing and storage of seismometric information becomes imperative. The transition in seismology from the use of analog to digital information required the creation of a flexible and reliable system with complex mathematical software. The following issues will be considered:

- state of research and prospects of automation of seismometric studies
- automated seismic analysis system " Epicenter»
- processing of instrumental observations
-program for determining the coordinates of the epicenters
- programs for determination of energy characteristics

KNOWLEDGE, SKILLS AT THE END OF THE COURSE

As a result of mastering the discipline the undergraduate must:

Know:

- basic concepts of databases and their purpose;
- DBMS database management tools;
- seismic databases "Catalogue", "Bulletin", "hearth Mechanism" and their structure
- current models of the Earth on seismological data;

Be able to:

- carry out systematization and analysis of the obtained and published data;
- use the automated system " Epicenter»
- assess the reliability and accuracy of the results obtained; to effectively use the available software for the analysis of seismograms

- deduce correct regularities on the basis of comparison of results of observations and the theory;
- conduct analysis of the obtained results;

Possess:

program for the selection of aftershocks in the machine catalog of earthquakes;
-computer programs for plotting the frequency of occurrence of earthquakes
- skills of mastering a large amount of information;
- skills of independent work .