

KAZAKH NATIONAL UNIVERSITY AL-FARABY

**Approved at the meeting
Scientific and methodological council
KazNU. Al-Farabi
Protocol No. 6
From "22" 06 2020**

**PROGRAM
INTRODUCTORY EXAMINATION FOR DOCTORS FOR EDUCA-
TIONAL PROGRAMS
«8D07301 - Geodesy»**

ALMATY 2020

The program is compiled in accordance with the State General Education Standard in the educational programs «8D07303-GEODESY". The program was compiled by Candidate of Technical Sciences, Senior Lecturer Jangulova G.K., Doctor of Technical Sciences, Professor Kasymkanova Kh.M., candidate of geological sciences., Senior Lecturer Shmarova I.N..

The program was considered at the meeting of the department
Protocol No. 39 of 16.06.2020

Head of the Department of Cartography and Geoinformatics _____
Kasymkanova H.M.

Approved at the meeting of the method bureau of the Faculty of Geography and
Nature Management

Protocol No. 8 of 19.06.2020.

Chairman of the Method Bureau _____

Approved at the meeting of the Academic Council

Protocol No. 8 of June 19, 2020г.

Chairman of the Academic Council

Dean of the Faculty of Geography and Environmental

Sciences _____ Salnikov V.G.

Scientific secretary _____ Abdreeva Sh.

CONTENT

1. Goals and objectives of the entrance examination in the specialty

The purpose of the entrance examination is to identify the degree of theoretical preparation for undergraduates.

The task of the entrance examination is to identify the ability of students to do research work.

2. Requirements for the level of training of persons applying To doctoral studies

The applicant must have a state document of the corresponding level of higher education.

Prior education level

- A) higher basic education (master's) in the field (majors):
6M060900-Geography, 6M071100-Geodesy, 6M074100-Cartography
- B) higher special education in the field (specialties):
220200 - Automated systems for information processing and control;
511025 - Geoinformatics and others.

3. Prerequisites for the educational program

Geodetic studies of the dynamics of geomorphological processes, Physical geodesy, Space geodesy, Geoinformation systems in geodesy and cartography.

4. The list of examination topics

Discipline "Geodetic studies of the dynamics of geomorphological processes»

The principles of the study of geomorphological processes in the historical aspect. The scientific and applied value of geomorphology. Ways of development of geomorphology and its current state. Genesis and age of relief. The concept of forms and elements of landforms. Determination of relief forms by size (planetary, megaforms, macroforms, mesoforms, microforms, nanoforms) Genesis and age of relief. Relief factors. Properties of rocks and their role in relief formation. Relief and geological structures. Relief and climate.

The relief-forming role of vertical and horizontal movements of the earth's crust. Folded irregularities and their manifestations in the relief. Scheme of construction of an observation station for determining vertical displacements. Exogenous

processes and their connection with the relief. Relief forms associated with intrusive (deep) magmatism. The role of horizontal displacements, curvature, radius of curvature. Values of displacement (shift) of points and deformation of the earth's surface.

Geodetic observations of the deformation of the earth's surface. The nature of the distribution of displacements and deformations of the earth's surface in the main sections of the mold Field observation methods. Electronic total stations and related field measurements. Electronic and laser theodolites. Digital, laser levels and plane builders. Methods for calculating the profile lines of long-term, ordinary and briefly temporary observation stations.

Earth geodynamics, geological structure of rock massif: tectonics, seismicity. The stressed state of the rock mass. Tectonic and seismic processes in Kazakhstan. The technique of geodesic observations of landslide phenomena. Methods of building an observation station in the area of landslides. Spatial features of the manifestation of sloping geodynamic processes and possible risks. The principle of planned binding filming. The differences in the height of the geoid significantly affect the result of GPS leveling in the study of deformation processes. The role of modern GPS measurements in scientific research. Requirements for the accuracy and efficiency of high-altitude geodetic measurements. Geometry of the Earth and o Global reference systems in the GPS era.

The magnitude of the horizontal forces during an earthquake. Classification of the earth's crust by tension and geodynamic hazard. Possibilities of geodetic survey of the territory in the area of geodynamic polygons. The principle of creating three-dimensional terrain models and engineering objects. Experience in applying the method of geodynamic zoning of the subsoil. The use of GPS in geodynamic ranges. Future GPS satellites. New signal structure. Methods of controlling the geodynamic processes of a rock mass during the development of mineral resources and the earth's surface.

Microcracks in nature. High-precision geodetic observations of microcracks. The highest points of the Earth and the greatest depths of the oceans. Geodesic support of geodynamic safety in areas subject to earthquakes. Vertical oscillatory motion of the earth's crust. Field observations performed during geomorphological studies (visual and instrumental). Deep faults and tears of the earth's crust. The technology of placement of the observation station and measurement features in the area of displacement and displacement trough. Tectonic force field and its difference from gravitational.

The purpose of laying long-term observation stations. The technique of observations, the required accuracy of determining the position of benchmarks in the vertical and horizontal planes, the frequency of observations. The manifestation of positive and negative modern tectonic movements of the earth's crust. Field work during shooting with a combination with cameral processing of shooting materials. The need for geodetic control of landslide processes. The principles of application of GIS technologies in processing the results of measurements of displacement processes.

Discipline "Physical Surveying"

Fundamentals of potential theory, including spherical and ellipsoidal functions. The potential of a solid. Harmonic functions. Laplace equation in spherical coordinates. Surface spherical functions. Spherical and rectangular coordinates. Spherical and spherical functions. Legendre functions. Legendre polynomials Legendre functions of the second kind. Types of spherical harmonics: zonal, tesseral, sectorial. Molodensky theory.

Expansion in spherical functions and the concept of orthogonality Solution of the Dirichlet problem using spherical functions and the Poisson integral. Fully normalized spherical functions. Expansion of the reciprocal distance in a series of zonal harmonics and the formula for adding spherical functions.

Earth's gravity field. Level surfaces and steep lines. Curvature of level surfaces and steep lines. Natural coordinate system. Earth's potential in terms of spherical functions. Series expansion in spherical functions. Spherical functions of lower degrees. Gravitational field of a level ellipsoid. Normal gravity. Study of Clairaut's Theorems. Expansions in a series of a normal gravitational field. Reference ellipsoid: numerical values.

Modern data on the theory of the reference ellipsoid Geodetic reference frame 1980 (GRS 1980). Free air reduction. Isostatic reduction. Topographic-isostatic reductions. Helmert condensation reduction. Helmert condensation method

Versatility of reduction in free air. Geodesic heights. Geometric leveling Geopotential numbers and dynamic heights. Comparison of different height systems. Determining heights in triangulation by measuring zenith distances.

GPS leveling. The height difference of the geoid significantly affects the result. The role of modern GPS measurements in scientific research. Geometry of the Earth. Global reference systems in the GPS era. The development of three-dimensional geodesy. Global positioning system. Maps of heights of Quasigeoid. Classes or types of GPS satellites. - Block I, Block II, Block IIA, Block HR, Block IIR-M and future satellites Block IIF and Block III.

Satellite signal and objects of observation. Signal components. Code pseudorange. GPS upgrade concepts. Future GPS satellites. New signal structure. A modern approach to determining the shape of the Earth. Gravimetric methods. Gravity reduction and geoid. Ellipsoidal functions. Plumb deviations. Connection with ellipsoidal geodetic coordinates. Gravity disturbances: GPS case. Gravity reduction in modern theory. Statistical Methods of Physical Geodesy Numerical values for calculating WGS 84 designs. Numerical comparisons of the GRS 1980 and WGS 84 systems. The application of the laws of physical geodesy in scientific research.

Discipline "Space Geodesy»

Space geodesy in the historical aspect of development in the world. Analysis of the prospects for the application of space geodesy methods in Kazakhstan.

Classification of coordinate systems (training). Coordinate-temporal support of tasks of space geodesy. Relations between the scales of stellar and average solar time.

Scales of the universal, ephemeris, atomic times. Topocentric and geographical coordinate systems. GPS Navigation Systems (Global Positioning System) and GLONASS (GLOBAL Navigation Satellite System). The timeline is not used to count time. The phenomena of daily rotation of the bodies. Factors that distort the position of the stars in the celestial sphere. Nutation, aberration, precession, parallax, refraction. Analysis of time systems in the CG. Declination of the sky equator.

The task of two bodies and the motion of the satellite. The undisturbed movement of an artificial earth satellite. Statement of the problem and differential equations. Types of unperturbed motion (elliptical, parabolic, hyperbolic, circular, rectilinear). The problem of the motion of an artificial Earth satellite in a first approximation.

The perturbed motion of an artificial Earth satellite. Spatial elements of the orbit of an artificial Earth satellite and its ephemeris. Methods for calculating rectangular heliocentric and geocentric coordinates. Geometric methods of space geodesy. The use of geometric methods KG. Geodetic reference frame 1980 (GRS 1980). Terrestrial and space imagery.

Ways to build satellite triangulation. Spatial elements of the orbit of an artificial Earth satellite and its ephemeris. Designing satellite triangulation. The motion of an artificial Earth satellite from the point of view of an earth observer. Visibility conditions of the artificial Earth satellite at the observation point. Requirements for the configuration and parameters of satellite orbits.

Dynamic tasks of space geodesy. Calculation of the main parameters of the Earth. Geometry of the Earth. Global reference systems in the GPS era. General principles for determining gravitational disturbing accelerations. Artificial satellite of the Earth and the duration of observation. Construction of a network of chord vectors spread over the entire surface of the Earth.

Satellite signal and objects of observation. Signal components. Code pseudorange. GPS upgrade concepts. Future GPS satellites. New signal structure. New technologies. Satellite Gradientometry. Systems of high-precision sea and land navigation. The fundamental equation of space geodesy. The motion of an artificial satellite relative to the center of mass. The theory of flight of artificial Earth satellites. Orbital methods of space geodesy. Methods for determining orbits.

Navigation satellite system, positioning. The use of space geodesy in scientific research.

Discipline "Geoinformation systems in geodesy and cartography»

General information about GIS. Overview of modern GIS used in geodesy and cartography. GIS classification by territorial level, purpose, architecture. GIS technical components. GIS infrastructure. Domestic and foreign full-featured GIS. Features of full-featured GIS. Features of the use of GIS for solving applied problems of geodesy and cartography.

Software Development Tools (software). GIS software development stages. Software components or libraries. Well-known software development environments in various programming languages (Microsoft Visual C ++, Borland / Inprise Delphi). Systems including data input, storage, complex queries, spatial analysis, data output, own programming languages.

Spatial data models. The main technological stages of data processing in GIS. Digital modeling and digital models (digital cartography, digital map, digital terrain model, digital terrain model, digital area model). Spatial data models. GIS information base - digital models of reality (digital, analog). Digital data models (raster, vector).

GIS panorama project. Technology, software structure. GIS technology. The main tasks solved in GIS. Software structure. Types of processed data. The technology for creating and updating the central technological platform, digital terrain model, digital terrain model, three-dimensional scenes using GIS tools. Classification and coding system, digital description rules, sign system, presentation formats. Quality Control Tools.

Remote sensing of the Earth and GIS. Remote sensing of the Earth. Features of the software for processing remote sensing of the Earth. Digital photogrammetric systems (domestic, foreign). The concept and principles of laser location.

5. List of sample questions for preparation for the exam

Main literature:

1. Genike A.A. Global satellite positioning systems and their application in geodesy / A.A. Genique, G.G. Pobedinsky. - M.: Kartgeocenter, 2004. -- 355 p.
2. Planet Earth. Encyclopedic reference book. Volume "Tectonics and Geodynamics" / Edited by L. I. Krasny, O. V. Petrov, B. A. Bluman. St. Petersburg: Publishing House All-Russian Research Geological Institute, 2004. 652 p.
3. Hain V.E., Lomize M.G. Geotectonics with the basics of geodynamics: A Textbook. 2nd edition, revised and supplemented Moscow: KDU, 2005. 560 p.
4. Belousov V.V. Fundamentals of geotectonics. 2nd edition., Revised and supplemented - Moscow: Nedra, 1989. 382 p.
5. Geodetic instruments and equipment / Catalog - M.: NPP Navgeokom, 2003. - 142 p.
6. Hoffmann-Wallenhof, B. Physical Surveying. Text: textbook / B. Hoffmann-Wallenhof, G. Moritz; per. from English Yu.M. Neumann, L.S. Sugaipova. M.: MIIGAiK, 2007, - 426 pp.: ill.

7. Dementiev, Yu.V. Taking into account the influence of topographic masses in calculating the disturbing potential Text. / U.V. Dementiev // Bulletin of the SSGA. Novosibirsk: SSGA, 2010. Issue. 1 (12). - P. 44 - 48.
8. Dementiev, Yu.V. On reductions of gravity Text. / Yu.V. Dementiev // Proceedings of the VI International Scientific Congress "GEO-Siberia-2010". Novosibirsk, 2010 .- P. 158 - 163.
9. Dementiev, Yu.V. Building a planetary digital elevation model and its application Text. / U.V. Dementiev, E.H. Kulik, E.V. Dergacheva // Proceedings of the VI International Scientific Congress "GEO-Siberia-2010". - Novosibirsk, 2010. -T. 1, part 1. -WITH. 170-173.
10. Workshop on Surveying: Textbook for universities / Ed. G.G. Poklada. - M.: Academic Project; Triksta, 2011 .- 470 p.
11. State cartographic and geodetic service / under the total. ed. A.V. Borodko. - M.: FSUE "Kartgeocenter", 2004. - 184 p.
12. Glushkov V.V., Nasretdinov K.K., Sharavin A.A. Space geodesy: methods and development prospects. M.: Institute of Political and Military Analysis, 2002. -302 p.
13. Ishmukhametova M.G., Kondratieva E.D. Solving problems in celestial mechanics and astrodynamics. - Kazan, 2009, 37 p. (Electronic edition <http://ksu.ru/f6/k8/index.php>).
14. V. I. Krylov "Space Geodesy" - Moscow: MIIGAiK, 2002. - 168 p.
15. Guidelines for the creation and reconstruction of urban geodetic networks using GLONASS / GPS satellite systems. GKINP (ONTA) - 01 - 271 - 03. - M.: TsNIIGAiK, 2003. - 182 p.
16. Izbachkov Yu.S. Information systems: Textbook for high schools / Yu.S. Izbachkov, V.N. Petrov. - 2nd ed. - St. Petersburg.: Peter, 2005.-- 656 p.
17. Gvozdeva T.V. Information Systems Design: Textbook / T.V. Gvozdeva, B.A. Ballod. - Rostov n / a: Phoenix, 2009. -508 p.
18. Baldin K.V. Information Systems in Economics: Textbook / K.V. Baldin, V.B. Utkin. - M.: Publishing and trading corporation "Dashkov and Co", 2006. - 395 p.
19. Golitsyna O.L. Information systems: textbook. allowance / O.L. Golitsyna, N.V. Maximov, I.I. Popov. - M.: FORUM: INFRA-M, 2007.-- 496s.
20. Maklakov S.V. Business Process Modeling with AllFusion PM. - 2nd ed., Rev. and add. - M.: Publishing House Dialog-MEPHI, 2008. - 224 p.
21. Sovetov B.Ya. Information technology: Textbook for high schools / B.Ya. Sovetov, V.V. Tsekhanovsky. - 2nd ed., Erased. - M.: Higher school., 2005 .- 263 p.
22. Geoinformatics. In 2 kn. Training for universities. Ed. V.S. Tikunova. 3rd ed., Re. and add. M.: Academy, 2010. Book. 1, 400 p., With color ill.; Prince 2, 432 s.
23. Tikunov V.S. Modeling in cartography. M., Moscow State University, 1997, 405 p. 5. Devices, systems and software / Catalog - Almaty: EATS LLP Leica Geosystems, 2003.- 64 p.

Additional literature:

1. Engineering geodesy: a textbook for high schools / E.B. Klyushin, M.I. Kiselev, D.Sh. Mikhelev [et al.]; under the editorship of D.Sh. Mikheleva. - M.: Higher. school., 2000.- 464 p.
2. Instructions for the development of filming justification and shooting of the situation and terrain using the global navigation satellite systems GLONASS and GPS. GKINP (ONTA) - 02 - 262 - 02. - M.: TsNIIGAiK, 2002. - 124 p.
3. Demyanov, G.V. Construction of a common Earth system of normal heights Text. / G.V. Demyanov, A.N. Mayorov, M.I. Yurkina // Geodesy and Cartography. 2009.-№.1. - Page 12 - 16.
4. Ipatov V. Broadband systems and code division of signals. - M. Technosphere, 2007, 487 p.
5. Grewal M.S., Weill L.R., Andrew A. P. Global Positioning Systems, Inertial Navigation, and Integration, with MATLAB, John Wiley & Sons, 2000.
6. Grewal M.S., Andrew A. Kalman filtering: Theore and Practice Using Matlab, second edition. – Jew York, John Wiley & Sons INC, 2001 pp 401.
7. Devices, systems and software / Catalog - Almaty: EATS LLP Leica Geosystems, 2003.- 64 p.
8. Povalyaev A.A., Satellite radio navigation systems: time, clock readings, measurement measurements and determination of relative coordinates. - M. Radio Engineering 2008, 328 p.
9. Lipkin I.A. Satellite radio navigation systems. - M. University Book, 2001, 285 p.
10. Kolesov Yu.B. Modeling systems. Object Oriented Approach. Textbook / Yu.B. Kolesov, Yu.B. Senichenkov. - SPB.: BHV-Petersburg, 2006.-- 192 p.
11. Dushin V.K. Theoretical Foundations of Information Processes and Systems: Textbook / V.K. Dushin. - M.: Publishing and trading corporation "Dashkov and Co", 2006. - 348 p.
12. Volkova V.N. Information systems: Textbook. allowance / Ed. V.N. Volkova, B.I. Cousin. - SPb.: SPbSTU, - 2001. - 216 p.
13. User Manual TC (R) 303/305/307 - Heerbrugg: Leica Geosystems, 2000. - 129 p.
14. Automated technology for research and design - M.: Arcada LLC, 2001.- No. 3 (5), pp. 47-48.
15. Rusak V.M., Rusakova L.I., Pigin A.P., Kuzmicheva E.V., Vasilkov D.M. Organization of paperless technology “From research to project” using CREDO_DAT, CREDO_TER, CREDO_LIN systems Minsk: NGO “CREDO DIALOGUE”, 2000. - 26 p.

6. Comprehensive Exam Scale

Letter Grade	The digital equivalent of points	% content	Traditional system assessment
A	4,0	95-100	Excellent
A-	3,67	90-94	
B+	3,33	85-89	Good
B	3,0	80-84	
B-	2,67	75-79	
C+	2,33	70-74	Satisfactory
C	2,0	65-69	
C-	1,67	60-64	
D+	1,33	55-59	
D-	1,0	50-54	
F	0	0-49	Unsatisfactory

“A” - Excellent: Must demonstrate a complete understanding of the issues, the main stages in the development of cartographic science and the paradigm shift in the evolution of science; demonstrate the scientific concepts of world and Kazakhstani science in the field of cartography, thematic geoinformation mapping; to know current trends, directions and patterns of development of domestic science in the context of globalization of economic, social or political problems and internationalization of the world community; critically analyze, evaluate and compare various scientific theories and ideas; process information on cartography, thematic geographic information mapping from various sources; demonstrate the presence of a significant amount of scientific knowledge acquired systematically and reflecting the current state of the scientific industry or field of professional activity; be able to develop and implement projects to create new knowledge or practical applications in relevant areas of the relevant scientific industry and the ability to adapt projects in the light of unforeseen unforeseen problem situations.

A complete answer on the merits of the question, with the necessary formulas, graphs, drawings and their explanations. Full systemic knowledge and presentation of educational material, a description of both the basics and the details of the topic under consideration, the absence of errors on the merits of the issue.

“B” - Good: Must demonstrate a significant understanding of issues, trends, ideas and processes, - be able to carry out further theoretical and / or applied research and development at a high level, making a significant contribution to the creation of

new ideas, approaches and methods; have the skills of oratory and public speaking in defense of the dissertation, international scientific forums, conferences and seminars in the field of cartography; possess personal qualities and system skills necessary for employment in areas requiring personal responsibility and significant independent initiative in complex and unpredictable professional situations.

A partial (or superficial) answer on the merits of the question, without significant errors; the answer is essentially the question, but with significant errors or there are no necessary formulas, graphs, figures, and their explanations. Conscious presentation of most of the program material, the presence of minor errors.

“C” - Satisfactory: The answers indicate a significant misunderstanding of the problems, various general scientific and concrete scientific approaches and methods of study, accepted in the cartographic branch of knowledge, as well as political and socio-economic phenomena. He has only the skills to use information technology to simplify research and practical work, the inability to analyze problems caused by anthropogenic processes, look for solutions, integrated management and monitoring of changes, draw conclusions.

The answer is not a complete (30%) presentation of the material with numerous significant errors (there is an answer, but not the substance of the question, i.e. the answer is on another question of the discipline program).

“D” - Bad: A rejection of the answer or answers indicate a complete lack of understanding of the problem. Understanding and using ideas and thoughts related to the main problems of ecology and nature management of global, regional local scales.

Response Rating Scale

№ of exam ticket questions	Response score (points)
Вопрос 1	100
Вопрос 2	100
Вопрос 3	100
Final grade	$100+100+100 / 3$

Head of Department
 cartography and geoinformatics
 Doctor of Technical Sciences,
 Professor

_____ Kasymkanova H.M.