APPROVED
at the meeting of the
Academic Council
of NJSC Al-Farabi Kazakh
National University
Protocol №14 dated 16.06.2026

The program of the entrance exam for applicants to the PhD for the group of educational programs D085 – «Hydrology»

1. General provisions

1. The program was drawn up in accordance with the Order of the Minister of Education and Science of the Republic of Kazakhstan dated October 31, 2018 No. 600 "On Approval of the Model Rules for Admission to Education in Educational Organizations Implementing Educational Programs of Higher and Postgraduate Education" (hereinafter referred to as the Model Rules).

2. The doctoral entrance examination consists of an interview, writing an essay, and a subject-specific examination.

Component	Points
1. Interview	30
2. Essay	20
3. Examination in the profile of the educational program group	50
Total / Passing score	100/ 75

3. The duration of the entrance examination is 3 hours and 10 minutes, during which the applicant writes an essay and answers questions from an electronic examination ticket. The interview is conducted at the university prior to the entrance exam.

2. Procedure for the entrance examination.

1. Applicants for doctoral studies in the group of educational programs D085 - «Hydrology» write a problematic / thematic essay. The volume of the essay is at least 250-300 words.

2. The electronic examination card consists of 3 questions.Topics for exam preparation according to the profile of the group ofthe educational program.

Discipline **«Hydrometry»**

Topic 1: Organization of work of hydrological gauging stations

Sub-topic:

1. Classification of hydrological gauging stations by purpose, duration of work, method of equipment, their main types. Simple hydrological gauging stations (rake, pile, combined)

2. The purpose and objectives of determining the water discharge. Methods for determining water discharges. Selecting a river section. Marking and equipment of hydrometric lines. Determination of water discharges using the "speed-area" method"

3. Field chemical laboratory, necessary equipment. Determination of the chemical composition of water in the field and in the laboratory

Topic 2: Modern hydrometric instruments and water cadastre

Sub-topic:

1. Modern self-recording devices of water level, characteristics and principles of various hydrometric devices

2. Types of remote installations and principles of their operation (GR-70, GR-64)

3. Possible schemes of integrated automation of the hydrometeorological service. Installationof automated installations of ARMP (GR-103), ARMS, etc.

4. State accounting of the water amount and its use. The main sections of the state water accounting and its information support. State Water Cadastre and its sections. Data publication, datastorage.

Discipline **«Fundamentals of hydrology»**

Topic 1: Hydrosphere, hydrological regime and hydrological processes

Sub-topic:

1. Water resources of the world continents, CIS countries, Kazakhstan
2. The main zonal and azonal factors affecting the regime of land waters
3. Hydrological features of various regions of Kazakhstan

Topic 2: River hydrology

Sub-topic:

1. The hydrological regime of the river, the phases of the water modes

2. Classification of rivers depending on the water regime, classification of rivers A. I. Voeikov,

M. I. Lvovich, B. D. Zaikov, P. S. Kuzin)

3. The river and the river system. Hydrographic network. Morphology and morphometry ofrivers and river basins

4. River runoff. Characteristics of the annual runoff. Typical hydrograph

5. The impact of economic activity on the river regime. Anthropogenic changes in river flow.

Topic 3: Hydrology of lakes, reservoirs, glaciers, and swamps

Sub-topic:

1. Origin and types, morphology and morphometry of lakes
2. Thermal regime and classification of lakes. Features of reservoir hydrology

3. Main characteristics of reservoirs. Siltation of reservoirs. Impact of reservoirs on river flowand the environment

4. Glaciers, distribution, and their regime. Hydrological features of glaciers.

5. Swamps, occurrence, development. Types of swamps, hydrological regime, distribution Discipline **«Hydrological calculations»**

Topic 1: Study and application of methods and techniques for calculating thecharacteristics of annual river runoff

Sub-topic:

1. Factors of river runoff
2. Methods of analysis of hydrological information
3. Patterns of annual runoff fluctuations
4. Calculation of the flow rate with a sufficient period of hydrological observations and withinsufficient and no data
5. Variability of the annual runoff and methods for determining its values of the specifiedprobabilities of excess
6. Intra-annual flow distribution
7. Minimum runoff

Topic 2: Calculation of the maximum river runoff

Sub-topic:

1. The value of maximum water discharges for construction design and water management
2. Calculation of the maximum runoff in the presence of observation materials
3. Calculation of the maximum runoff for short rows and the absence of observationmaterials
4. Maximum runoff of floods and floodings
5. Construction of flood and floodings flow hydrographs
6. Determination of estimated water levels of rivers and lakes
7. Calculation of sediment runoff

Discipline**: «Modern methods of statistical processing of hydrological information» Topic 1: Distribution curves and their characteristics. Statistical hypothesis testing**

Sub-topic:

1. Random variables and the laws of their distribution.
2 The normal distribution law, the Pearson probability curve of the third type. The probabilitydistribution curve of S. N. Kritsky and M. F. Menkel
3. Estimation of the distribution parameters by the methods of moments and maximumlikelihood, as well as by the graphoanalytic method
4. Statistical testing of hypotheses in hydrological studies. The Student and Fisher criterion
5. Nonparametric methods for testing hypotheses. The Wilcoxon, Mann-Whitney, Dixon,Smirnov-Grubbs criterion.

Topic 2: Statistical dependencies in hydrology and statistical modeling of hydrological series

Sub-topic:

1. Linear regression and correlation.
2. Multiple linear regression and correlation.
3. Studies of the regularity of fluctuations in time hydrological series
4. Multivariate statistical analysis. Studies of the regularity of fluctuations in time

hydrological series

5. Statistical simulations of annual runoff series and runoff hydrographs

Discipline**: «Hydrological forecasts»**

Topic 1: **Short-term hydrological forecastsSub-topic**:

1. Assessment of the quality of the methodology and the feasibility of hydrological forecasts. The permissible error of the forecast and its determination. Criteria for the applicability and quality of the forecast methodology. Special cases of evaluating the quality of the methodology.

2. Short-term forecast of the water level by the method of the corresponding levels in the non-flowing area

3. Short-term forecasts of rain floods. Methods of rain runoff hydrograph forecast

4. Forecast of the timing of the appearance of ice on rivers, lakes and reservoirs. The methodof L. G. Shulyakovsky

5. Short-term forecasts of the opening of rivers, lakes and reservoirs.

Topic 2: **Long-term hydrological forecasts**

Sub-topic:

1. Fundamentals of the methodology for long-term forecasts of spring flood runoff. The equation of the water balance for the period of high water. Determination of the total amount of waterentering the basin surface.

2. Determination of snow reserves remaining in the basin based on the initial value of snow reserves and the air temperature for the melting period.

3. Long-term forecasts of maximum water discharge (levels). Hydrograph forecast of spring flood runoff.

4. Long-term forecasts of summer, autumn and winter runoff. Methods for forecasting low- water runoff in steppe, forest-steppe and forest zones.

5. Forecasts of ice phenomena based on the synoptic-statistical method. Forecasts of the appearance of ice on rivers. Forecasts of river opening. Forecasts of ice freezing and destruction on lakes and reservoirs.

Discipline**: «Integrated water resources management» Topic 1**: **Water resources and sustainable development**

Sub-topic:

1. Water resources and sustainable development. The importance of water for the environmentand humans. The global water crisis.

2. The need for transition to IWRM in Kazakhstan. Policy and legislation in the field of waterresources management of the Republic of Kazakhstan. The main provisions of the Water Code of theRepublic of Kazakhstan.

Topic 2: **Information management in the field of water resources use and protection**

Sub-topic:

1. Monitoring of water resources. Goals and objectives of monitoring water bodies. Principlesof forming a system for monitoring water bodies. Subjects of the monitoring system.

2. Problems of optimization of monitoring of water resources of the water management basinof the Republic of Kazakhstan.

3. International cooperation in the field of IWRM and improving the management oftransboundary water bodies.

4. International agreements in the field of IWRM on transboundary watercourses.

5. International practice of cooperation in transboundary river basins in the field of IWRM.Discipline**: «Hydrology of urbanized territories»**

Topic 1: **Assessment of changes in river flow under the influence of**

anthropogenic factors

Sub-topic:

1. The current state of the study of the impact of economic activity on water resources and thehydrological regime of urbanized territories.

2. Methods for assessing the impact of various types of economic activity on runoff.

3. Water management and environmental problems of large river basins. Modern problems ofregulating the state of water resources, drinking water supply and rational use.

4. Redistribution of runoff under the influence of urbanization. Surface wastewater treatment plants.

5.

6. Protection of the territories of cities and settlements from floods and rising water levels.

Discipline**: «Ameliorative hydrology»**

Topic 1: **Hydrological and climatic reason of irriation meliorations**

Sub-topic:

1. The effect of land amelioration on the soil, plants and microclimate.
2. Irrigation systems
3. Theoretical foundations of hydrometeorological reasoning of landmelioration

Topic 2: **Hydrometeorological calculations for irrigation ameliorations**

Sub-topic:

1. The main elements of the water balance of irrigated land.
2. Fundamentals of hydrological and climatic assessments of the natural moisture supply ofthe territory.
3. Return flow from irrigation systems.
4. Irrigation regime and its calculation in the design of irrigation measures.

Discipline**: «Mudflow problems and mudflow protection»**

criteria

Topic 1: **Problems of mudflow forecasting**

Sub-topic:

1. The problem of mudflow forecasting, types of forecasts, authors, proposed prognostic

2. Forecast of rainfall generated mudflows, determination of their prognostic criteria

3. The role of GIS technologies in mudflow forecasting

4. Forecast of glacial generated mudflows, determination of their prognostic criteria.

Topic 2: **Problems of mudflow risk management**

Sub-topic:

1. Assessment of mudflow protection activities carried out in Kazakhstan, mudflow protection activities, mudflow protection constructions, Kazakhstan and world

experience.

2. Measures aimed at protecting against rainfall generated mudflows.
3. Justification of the activities carried out in the inter-mudflow period.
4. Prevention of glacial mudflows
5. Justification of the activities carried out during the passing throw mudflows.
6. Justification of the activities taken after the mudflow passing.

Discipline**: « Modern digital technologies in hydrology»**

Topic 1: **Possibilities of application of computer technologies in modeling and forecastingof hydrological processes**

Sub-topic:

1. Hydrological processes and regularities of their formation
2. The role of hydrological models in forecasting hydrological processes
3. Analysis of prospective ways of forecasting hydrological processes.Use of remote sensing data in the study of hydrological phenomena and processes
4. Organization of monitoring activities using remote sensing data in the occurrence ofdangerous hydrological phenomena.
5. Evaluation of the integration of remote sensing and GIS technologies.

3. List of references.

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