APPROVED
at a meeting of the Academic Council
of NJSC «KazNU named after al-Farabi»
Protocol № 11 from 23.05.2025 y.

Entrance Examination Program for Applicants to Doctoral Studies in the Educational Program Group D087 – "Environmental Protection Technology"

I. General Provisions

1. This program is developed in accordance with the Order of the Minister of Education and Science of the Republic of Kazakhstan dated October 31, 2018, No. 600 "On the Approval of Standard Rules for Admission to Education in Organizations Implementing Educational Programs of Higher and Postgraduate Education" (hereinafter referred to as the Standard 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.

II. Procedure for the Entrance Examination

1. Applicants to the doctoral program in the educational program group D080 – "Biology" are required to write a **problem-based or thematic essay**. The essay must be **at least 250 words** in length.

Purpose of the essay: To assess the applicant's level of analytical and creative abilities, as demonstrated by their ability to construct their own arguments based on theoretical knowledge, social and personal experience.

Types of essays:

- **Motivational essay** disclosing the applicant's motives for pursuing research;
- **Scientific-analytical essay** justifying the relevance and methodology of the proposed research;
- **Problem-based/thematic essay** reflecting various aspects of scientific knowledge in the subject area.

2. The **electronic examination ticket** consists of **3 questions**.

Topics for the Entrance Exam Preparation

(for the educational program group profile)

Discipline: "Ecology and Sustainable Development"

Topic 1. Autecology – Ecology of Individuals

Subtopics: Organisms and their environment. Environmental factors. Patterns of environmental factor effects on organisms. Liebig's Law of the Minimum. Shelford's Law of Tolerance. Adaptation to natural phenomena.

Topic 2. Demecology – Population Ecology

Subtopics: Population as a structural unit of species and an evolutionary unit. Population classification. Quantitative population indicators. Static indicators. Effect of environmental factors on populations.

Topic 3. Biogeocenology (Ecosystems and Their Environment). Synecology

Subtopics: Types of ecosystems, structure of biogeocenoses. Ecological interactions within ecosystems. Food chains. Energy in ecosystems. Energy pyramid law. Ecological pyramids.

Topic 4. Biosphere and the Biosphere–Noosphere Concept of V.I. Vernadsky and Biogeochemical Cycles

Subtopic 1: Evolution of the biosphere. The sphere of life. Vernadsky's biosphere–noosphere concept. Functions and properties of living matter. Basic properties of the biosphere.

Subtopic 2: Description of cycles: Water cycle. Carbon cycle. Oxygen cycle. Nitrogen cycle. Phosphorus cycle. Sulfur cycle. Xenobiotic cycle. Anthropogenic cycle and its impact on the biosphere.

Topic 5. Civilizational Challenges and Global Environmental Issues. Global Pollution of Biosphere Components

Subtopics: Civilizational problems. Global environmental issues. Energy issues. Demographic problems. Food security. Global pollution. Types of biosphere pollution. Global pollution of the hydrosphere, atmosphere, lithosphere.

Topic 6. Natural Resource Potential

Subtopics: Natural resources. Classification. Natural resource use. Issues of resource exploitation.

Topic 7. Protection of Water and Soil Resources and Their Rational Use

Subtopics: Sources of pollution of surface and underground waters. Wastewater treatment: Mechanical, physico-chemical, chemical, and biological methods. Rational use of Kazakhstan's water resources. Ecological state of Kazakhstan's soils. Land reclamation. Sources and causes of soil degradation and depletion.

Topic 8. Environmental Control and Monitoring of the Environment and Natural Resources

Subtopics: Environmental control. Monitoring. Monitoring system structure. Unified State System of Environmental and Natural Resource Monitoring.

Topic 9. Sustainable Development

Subtopics: Concepts and global models for the future of the world. Sustainable development in the Republic of Kazakhstan. International cooperation in environmental protection. Specially protected natural areas of Kazakhstan.

Discipline: "Geoecology"

Topic 1. Geoecology: System of Sciences on Integration of Geospheres and Society

Subtopic 1: Interdependence of the ecosphere and society
Subtopic 2: Systemic nature of geoecological problems

Topic 2. Natural Factors of the Ecosphere

Subtopic 1: Energy and material characteristics of the ecosphere
Subtopic 2: Thermal balance of the ecosphere
Subtopic 3: Role of the biosphere in ecosphere functioning

Topic 3. Socioeconomic Factors of the Ecosphere

Subtopic 1: Main groups of ecosphere condition factors
Subtopic 2: World population as a geoecological factor
Subtopic 3: Consumption of natural resources and geoecological "services"
Subtopic 4: Geoecological role of technological progress

Topic 4. Global Changes and Strategies for Humanity

Subtopic 1: Potential capacity of territories
Subtopic 2: Elements of survival strategies for humanity
Subtopic 3: Indicators of geoecological conditions and sustainable development

Topic 5. Human Impact on Earth’s Atmosphere and Climate

Subtopic 1: Main characteristics of Earth’s atmosphere and climate
Subtopic 2: Ozone layer depletion
Subtopic 3: Ecosphere acidification and acid rain
Subtopic 4: Local air pollution

Topic 6. Human Impact on the Hydrosphere

Subtopic 1: Main characteristics of the hydrosphere
Subtopic 2: Main functions of inland waters in the ecosphere
Subtopic 3: Geoecological aspects of water management
Subtopic 4: Geoecological features of endorheic (closed drainage) regions
Subtopic 5: Water quality, scarcity, and degradation of freshwater resources
Subtopic 6: Geoecological issues of marine coasts and inland seas

Topic 7. Geoecological Problems of Soil and Land Use

Subtopic 1: Basic functions of the soil sphere
Subtopic 2: Anthropogenic soil degradation
Subtopic 3: Global land resources and their use
Subtopic 4: Geoecological problems of agriculture

Topic 8. Human Impact on the Lithosphere

Subtopic 1: Earth structure and lithosphere, impacts on adverse exogenous processes

Topic 9. Human Impact on the Biosphere and Earth's Landscapes

Subtopic 1: Main features of the biosphere and its role in the ecosphere
Subtopic 2: Biotic management of the ecosphere and human influence
Subtopic 3: Deforestation issues
Subtopic 4: Desertification issues
Subtopic 5: Biodiversity conservation issues

Topic 10. Geoecological Aspects of Natural-Technogenic Systems

Subtopic 1: Natural-technogenic systems
Subtopic 2: Geoecological aspects of urbanization
Subtopic 3: Geoecological aspects of energy
Subtopic 4: Geoecological aspects of industry
Subtopic 5: Geoecological aspects of transportation
Subtopic 6: Geoecological aspects of agriculture

III. List of References Used

Main Sources:

1. Бигалиев А.Б. Общая экология. Учебное пособие. Алматы: Изд-во «NURPRESS», 2011. – 162 с.

2. Нуркеев С.С., Мусина У.Ш. Экология: Учебное пособие для технических вузов. – Алматы: МОиН РК, 2005. – 490 с.

3. Аубакирова К.Д., Базарбаева Т.А., Таныбаева А.К. Экология и устойчивое развитие: учеб.-метод. пособие. - Алматы: Қазақ ун-ті, 2015. – 260 с.

4. Колумбаева С.Ж. Экология и устойчивое развитие: учеб. пособие. - Алматы: Қазақ ун-ті, 2011. – 153 с.

5. Голубев Г.Н. Основы геоэкологии. Учебник. М.:ЛитагентКнорусс, 2013. – 416 с.

6. Оспанова Г.С., Бозшатаева Г.Т. Экология. А.: Экономика, 2002.

7. Бродский А.К. Экология: учебник. М.: КНОРУС, 2012.

8. *Комарова Н.Г.* Геоэкология и природопользование: учеб. пособие. М.: Академия, 2007

9. Прохоров Б.Б. Социальная экология: учебник для вузов. М.: Академия, 2007.

10. Тетиор А.Н. Городская экология: учеб. пособие. М.: Академия, 2007.

11. Трифонова Т.А., Селиванова Н.В., Мищенко Н.В. Прикладная экология: учеб. пособие. М.: Гаудеамус, 2007.

Supplementary Sources:

1. *Акимова Т.А., Кузьмин А.П., Хаскин В.В.* Экология: природа – человек – техника: учебник для вузов. М.: Экономика, 2007.

2. *Акимова Т.А., Хаскин В.В.* Экология: человек – экономика – биота – среда: учебник для вузов. М.: ЮНИТИ, 2007.

3. Ветошкин А.Г. Теоретические основы защиты окружающей среды: учеб. пособие. М.: Высшая школа, 2008.

4. Рудский В.В., Стурман В.И. Основы природопользования: учеб. пособие. М.: Аспект Пресс, 2007.

5. Передельский Л.В. Экология и охрана окружающей среды: учебник. М.: КНОРУС, 2013.

6. Экология. Геоэкология недропользования: Учебник для вузов / Милютин А.Г., ред. М.: Высшая школа, 2007.

Discipline: Hazardous Natural Processes

Topic 1: Modern Relief-Forming Processes and Their Classification

Subtopics:

Classifications of geomorphological (relief-forming) processes.

Cascade and paragenesis development of natural processes.

Topic 2: Modern Hazardous Natural Processes

Subtopics:

Droughts and their ecological consequences.

Desertification and its ecological consequences.

Erosional processes and their ecological consequences.

Karst processes and their ecological consequences.

Glacier activity and its ecological significance.

Topic 3: Adverse Natural Processes and Their Ecological Significance

Subtopics:

Waterlogging and its ecological consequences.

Riverbed changes.

Flooding, land subsidence, and their ecological consequences.

Topic 4: Modern Natural Catastrophic Processes and Their Ecological Significance

Subtopics:

Atmospheric vortices, hurricanes, and tornadoes.

Dust and salt storms.

Floods and their ecological consequences.

Earthquakes and their ecological consequences.

Snow avalanches and their ecological consequences.

Mudflows and their ecological consequences.
Landslides and their ecological consequences.
Wildfires and their ecological consequences.

Topic 5: Mapping of Hazardous Natural Processes

Subtopics:

Use of GIS technologies and remote sensing (RS) data in natural process studies.

Mapping the dynamics of natural processes.

Topic 6: Monitoring of Hazardous Natural Processes

Subtopics:

Types of monitoring

Forecasting the occurrence of hazardous processes

Geoecological aspects of adverse natural and anthropogenic processes and phenomena

Discipline: Natural and Technogenic Risk Management

Topic 1: Technogenic Systems, Risk Analysis, and Sustainable Development of Society

Subtopics:

Natural and technogenic systems.
Concepts of risk and hazard.
Risk indicators.
Risk and sustainable development issues.

Topic 2: Sources of Hazards and Classification of Risks and Hazards

Subtopics:

General characteristics of risk
Individual and collective risks
Potential territorial and social risks
Environmental risk
Spatial distribution of hazardous events and risks

Topic 3: Structure of Technogenic Risk

Subtopics:

Technogenic safety issues

Classification and nomenclature of potentially hazardous objects and technologies

Natural-technogenic risks
Accident hazards and their consequences
General structure of technogenic risk analysis

Topic 4: Methods of Technogenic Risk Analysis

Subtopics:
Hazard identification methods.
Basic concepts and definitions of reliability, safety, and risk theory.
Indicators of reliability, safety, and risk.
Statistical modeling method

Topic 5: Environmental Risk
Subtopics:
Key principles and criteria of risk management.
Structure of environmental risk.
Risk to public health and environmental pollution.

Topic 6: Issues and Methods of Managing Natural and Technogenic Risks
Subtopics:
Economic mechanisms of safety and risk management.
Regulatory frameworks for safety and risk.
Protection of the population from natural and technogenic emergencies.

III. List of References Used

Main Sources:

1. Акимов В.А., Лесных В.В., Радаев Н.Н. Основы анализа и управления риском в природной и техногенной сферах
2. Алымов В.Т., Тарасова Н.П. Техногенный риск. Анализ и оценка. Учебное пособие. М.,2001
3. Евсеева Н.С. Экологическая геоморфология. Опасные природные процессы: учебное пособие. – Томск : ТГУ, 2017. – 278 с.
4. Кочуров Б.И. Геоэкологическое картографирование. Учебное пособие. М., Академия. 2009.- 192 с.
5. Степанова Н.Ю. Техногенные системы и экологический риск. Учебное пособие. 2014.
6. Экологический риск. Научное издание. Составители: Ноговицын В.Н., Ноговицына. Иркутск, 2017. 362 с.

Supplementary Sources:

1. Акимова Т.А. Экология. Человек. Экономика. Биота. Среда. Учебник для вузов. 2-е изд. / Т.А. Акимова. - М.: Юнити-Дана, 2002, 2006. - 566 с.
2. Витченко А.Н. Геоэкология. Курс лекций. Минск.,2002. 100 с.
3. Комарова Н.Г. Геоэкология и природопользование: учеб. пособие- М. : «Академия», 2010. - с. 256.
4. Протасова Н. А. Геохимия техногенных ландшафтов. Учебное пособие для вузов. 2009. -37 с.
5. Чернышов В.Н. Теория систем и системный анализ : учеб. Пособие. Тамбов : Изд-во Тамб. гос. техн. ун-та, 2008. – 96 с.
6. Экологическая геоморфология : новые направления : учеб. пособие / под ред. С.И. Болысова. М. : Географ. фак. МГУ, 2015. 220 с.