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 D012 – «Teacher training in informatics»

I. 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 entrance exam for doctoral studies consists of writing an essay, an exam in the profile of a group of educational programs and an interview.

Block	Points
1. Interview	30
2. Essay	20
3. Exam according to the profile of the group of the educational program	50
Total admission score	100/75

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

II. Procedure for the entrance examination

1. Applicants for doctoral studies in the group of educational programs D012 - «Teacher training in informatics» write a problematic / thematic essay. The volume of the essay is at least 250words.

The purpose of the essay is to determine the level of analytical and creative abilities, expressed in the ability to build one's own argumentation based on theoretical knowledge, social and personal experience.

Types of essays:

- motivational essay revealing the motivation for research activities;
- scientific-analytical essay justifying the relevance and methodology of the planned research;

- problem/thematic essay reflecting various aspects of scientific knowledge in the subject area.

2. The electronic examination card consists of 3 questions

Topics for exam preparation according to the profile of the group of the educational program:
Discipline «Information educational technologies»

The concept of informatization of education. Factors influencing the informatization of education. The main directions of informatization of education. Stages of development of informatics and the informatization of education. The development of informatization of education in the Republic of Kazakhstan and abroad. The impact of informatization on the methodological system of teaching. Psychological and pedagogical foundations of informatization of education. An information-based approach to building a learning model. Informatization of education as a field of scientific research, scientific-pedagogical, and scientific-methodological research. Informatization of education as a field of teacher training.

Digital tools in modern educational practice. Psychological and pedagogical theories underlying the digitalization of education. Digital transformation of the educational environment in the context of technological progress. Evaluation of the quality of digital educational products and services. Personalization of learning based on digital tools and data analytics. Promising directions for the development of the digital educational ecosystem.

The concept of an information educational environment and its components. Features of learning in an information educational environment. Information educational space and its components. Features of learning in an information educational space. Information educational space as a system of information educational environments. Information and Telecommunication Technologies. Distance learning technologies. Information modeling technology and virtual reality. Virtual reality in the digital transformation of the educational process. Development of VR/AR solutions for visualizing educational content. Virtual laboratories as an innovative format for digital learning.

Student-oriented technologies for digitalization of education. Digitalization methods in teaching. Information modeling method. Penetration of digitalization methods into student-centered learning and developmental learning. Factors influencing the rationale and choice of digitalization technology and methods. Methods of digitalization of educational activities. Information and telecommunication technologies in the educational process. Stages of implementation of technical means of digitalization in education. Classification of technical means of digitalization of education.

Telecommunication means and their classification. Organization of distance learning, open education, and virtual institutions. Means of organizing interpersonal communication. Means of digitalization of monitoring and measuring learning outcomes. The concept and classification of global information resources. The concept and classification of educational information resources. Educational portals.

Resources of distance learning, open education, and virtual institutions. Resources for organizing interpersonal communication. Social networks. Information resources for monitoring and measuring learning outcomes. Information resources of extracurricular activities. Resources of scientific and methodological research. Resources of organizational and managerial activities. Use of cloud technologies and data centers. Factors influencing the rationale and selection of educational technology and information resources.

Teacher training in the context of digitalization of education. Competencies required of teachers in the context of digitalization of education. Factors influencing teacher readiness to use technologies, methods, and tools for digitalization of education. A system for training teachers in the field of digitalization of education. Methodological foundations of research in computer science education. Digitalization of computer science education at various educational levels. Scientific approaches to designing a digital educational environment. Integration of artificial intelligence into computer science teaching methods.

Artificial intelligence in the modern education system. Application of artificial intelligence to develop logical thinking. Intelligent technologies in special education. Intelligent educational systems with gamification elements. Artificial intelligence as a means of supporting the educational process. Integration of artificial intelligence into computer science teaching methods.

Discipline «Learning Problems»

Representation and coding of information using sign systems. Number systems and computer presentation of information. Information coding methods. Language as a form of information presentation (natural and formal languages). The main logical nodes of the computer: encryptors, decoder, adder, multiplexers and demultiplexers. Graphical representation of logical nodes and their truth tables. Methods for studying logical elements using the example of bit strings (based on an example of 8-bit).Stages and trends in the development of technical means and information resources. The architecture of modern computers. Basic computer devices: functions and modular-backbone principle of building a computer. The main directions and states of studying the architecture of modern computers in universities.Basic concepts of information technology. Historical preconditions for the development of information technology. Methodology of using information technologies in the educational process. The main directions of software development for modern computers. Software classification. Variety of operating systems. Server operating systems. Problems of introducing modern software into the educational process. Definition and structure of computer networks. Prospects for the development of local and global computer networks. Advantages and disadvantages of types of network topologies. Problems speeding up the loading of web pages and saving trafficA set of hardware and software for organizing computer networks. Internet addressing system. Client-server architecture. The main services of the Internet: e-mail, chat, teleconferences, forums and methods of their use in the educational process. Competition as a factor in the development of information

retrieval systems. Methodology and stages of introducing computer networks into the educational process. Characteristics of probabilistic and alphabetical approaches to the measurement of information. Information transfer rate. Data transmission medium. Methods for increasing the bandwidth of the communication channel.Wireless technologies and the main directions of their development. Problems and prospects for the development of network technologies, hardware, protocols, operating systems and their use in the educational process of the university. Educational network systems.Scientific and theoretical foundations of the use of educational Internet resources. The effectiveness of using hypertext technologies in education. Website creation technology. The use of these technologies and methods of their study in the educational process.Database. Modern database management systems. Data organization models. Relational data models. The integrity of relational data. Keys. Primary keys. Foreign keys. Generic keys. Methods for their study.Relational data models. Relational data objects. Subject area. Relations. Relationship diagram. The concept of "entity-relationship". Projection. Attribute. Functional dependency between attributes. Domain. Tuple. Examples of using relational data models in the educational process and methods of teaching them. Relational data models. Relational algebra. Basic operators of relational algebra. Computer implementation of relational algebra.Database. Triggers: Create and Apply. Trigger definition. Implementation of triggers and examples of use in the management of the educational process. Database. Transactions. Creation and deletion of a transaction. Transaction management. An example of using a transaction in managing the educational process. Intelligent systems. The main directions of intelligent systems and their teaching in the educational process of the university. The structure of intelligent systems. Design and computer implementation of an intelligent system. Expert systems. The main advantage and purpose of expert systems. Areas of application of expert systems. Knowledge base of expert systems. Educational expert systems. Algorithmization and programming basics. Algorithms. Data types. Physical implementation of data types in a computer system. Structures. Computer implementation of structures. Operators. The methods of their operators. Linear programming. Non-linear programming. Dynamic programming. Methods of their study in the educational process of the university. Computer modelling. Modeling of processes. The main stages of computer modeling.Informational resources. Educational information resources. Information ethics and law, information security. Protection of information. Legal and pedagogical aspects of the implementation of information security.Information Security. Security threats, methods and means of information protection. Computer viruses: definition and classification. Protection against computer viruses. The legal and pedagogical state of the teaching of computer viruses. Cryptographic protection methods. History of cryptography. Basic concepts and definitions. Requirements for cryptographic systems. Encryption algorithms. Methods for their study.Educational robots. The basics of introducing robotic tools into education. Types of educational robots. Educational robot software. The introduction of robots into the educational process of schools and universities. Distributed data. The main tasks of distributed data management systems. The use of

distributed data in education. Open systems concept. Clients and servers of local area networks. Client-server system architecture. Database servers. Database clients. The use of this technology in the organization of the educational process. Grid technologies. Basic concepts. Grid concept. Possibilities of grid technologies. Types of grid systems. Problems of the introduction of grid technology in the educational process.Cloud fundamentals. Cloud computing as a new way to deliver computing resources. Cloud structures. Types of clouds. The use of cloud technology resources in education. Parallel computing. Basic concepts of parallel computing. Parallel computing implementation environment. Promising areas of high-speed computing. The state of the study of parallel computing in the educational process of the university. Basic concepts of supercomputers. The history of the formation of supercomputers. State of use in the educational process.

Discipline «Programming languages»

Object Oriented Programming. Data type. Main components: Class of components. Class constructor. Operation New. Static class members. Data transformation. Grouping of operators. Real estate operator. Stop the operator. Interrupt operator. Continue operator. Completion operator. Return operator. Jump operator. The operator of the contract. Operation priorities. Subprocesses: class of threads, synchronization of subprocesses. Operators: loop operator. Loop stop operator. Selection operator. Arrays: an array and its characteristics. Methods for declaring a static array. Arrays: Methods for working with dynamic arrays and declaring arrays for placement. Input and output of arrays.Functions: internal and external functions. Data type. Actual and formal variables.General characteristics of programming languages. Types and data structures. Algorithms. Algorithms and programming languages. Basic constructions of modern programming languages. Methods, technologies and programming tools. Functions and methods. Procedural, logical, functional and object- oriented programming. Methods for efficient storage and processing of data. Files, databases. Object-oriented programming methodology. Classes and objects object-oriented programming technology. Matrices, vectors. String values. Files. Recursion. Graphs, trees. Combined tasks. Non- combined task.

III List of references

Main:

1. Современные инновационные технологии в информатизации образования: монография / Н.Н. Керимбаев. – Алматы: Қазақ университеті, 2020. – 126 с.

2. Соболева, М. Л., Бороненко, Т. А., Самылкина, Н. Н. *Теория и методика обучения информатике : учебное пособие для вузов*. — 3-е изд., перераб. и доп. — Москва : Издательство Юрайт, 2024. — 324 с.

3. Семакин, И.Г. Основы алгоритмизации и программирования: Учебник / И.Г. Семакин. - М.: Academia, 2017. - 384 с.

4. Гордиенко, О. В. *Современные средства оценивания результатов обучения. Практикум : учебное пособие для вузов*. — 2-е изд., испр. и доп. — Москва : Издательство Юрайт, 2024. — 115 с. — ISBN 978-5-534-07128-3.

5. Бидайбеков Е. Ы. Информатизация образования и проблемы обучения: /Автор. колл: Е. Ы. Бидайбеков, В. В. Гриншкун, Г. Б. Камалова, Д. Н. Исабаева, Б. Ғ. Бостанов/ учебник. – Алматы, 2014. – 352 с

6. Баранова, Е. В., Бочаров, М. И. *Информационные технологии в образовании : учебник для вузов*. — 4-е изд., стер. — Москва : Издательство Лань, 2023. — 408 с.

7. Информационные и коммуникационные технологии в образовании / Под.редакцией: Бадарча Дендева – М.: ИИТО ЮНЕСКО, 2018. – 320 стр.

8. Бидайбеков Е.Ы., Балыкбаев Т.О., Ибрагимова Н.Ж. Методические основы измерения результатов обучения школьников по информатике // Алматы, 2017. - 152 б.

9. Карр, Николас Великий переход. Революция облачных технологий / Николас Карр. - М.: Манн, Иванов и Фербер, 2017. - 737 с.

10. Магомедова Х.А. «Технические средства информатизации» для специальности среднего профессионального образования. Учебное пособие – Махачкала: ДГУНХ, 2017. – 117 с.

11. Баранова, Е.К. Основы информатики и защиты информации: Учебное пособие / Е.К. Баранова. - М.: Риор, 2016. - 199 с.

12. Zheng, L. Navigating Digital Transformation: The Dynamics of Educational Technology Adoption. — 1st Edition. — London : Routledge, 2025. — 254 p. — ISBN 978-1-032-76342-2.

13. В. Олифер, Н. Олифер "Компьютерные сети. Принципы, технологии, протоколы. Учебник" 2016 -992 с.

14. Jiang, B. Toward Trustworthy Adaptive Learning: Explainable Learner Models. — New York : Routledge, 2025. — 198 p.

15. Крёнке Д. Теория и практика построения баз данных, 8-е изд. "Питер", Издано: 2017, 800 стр.

16. Интеллектуальные информационные системы и технологии: учебное пособие / Ю.Ю. Громов, О.Г. Иванова, В.В. Алексеев и др. – Тамбов: Изд-во ФГБОУ ВПО «ТГТУ», 2013. – 244 с.

17. Майкл Мейн, Уолтер Савитч. Структуры данных и другие объекты в C++ 2-е издание 2002.

-832 стр.

18. Струченков В. Методы оптимизации: основы теории, задачи, обучающие компьютерные программы. Издательство: Директ-Медиа, 2015 -266 стр.

19. А.Л. Королев Компьютерное моделирование. Учебное пособие Челябинск- 2019 -189 стр.

20. Чупин Д.Ю., Ступин А.А., Ступина Е.Е., Классов А.Б. Образовательная робототехника: учебное пособие. — Новосибирск: Агентство «Сибпринт», 2019. — 114 с.

21. Кузнецов, С. Д. Основы баз данных / С.Д. Кузнецов. - М.: Бином. Лаборатория знаний, Интернет-университет информационных технологий, 2017. - 488 с.

22. Карр, Николас Великий переход. Революция облачных технологий / Николас Карр. - М.: Манн, Иванов и Фербер, 2017. - 737 с.

23. Павловская, Т. А. *Программирование на языке высокого уровня : учебник для вузов*. — 3-е изд., стер. — Санкт-Петербург : Лань, 2026. — 464 с. — ISBN 978-5-507-47890-3.

24. Баррон Введение в языки программирования / Баррон, Дэвид. - М.: Мир, 2016. - 192 с.

25. Альфред, В. Ахо Структуры данных и алгоритмы / Альфред В. Ахо, Джон Э. Хопкрофт, Джеффри Д. Ульман. - М.: Вильямс, 2016. - 400 с.

26. Вирт, Н. Алгоритмы и структуры данных / Н. Вирт. - М.: Мир, 2016. - 360

27. Абрамов, С.А. Математические построения и программирование / С.А. Абрамов. - М.: Наука, 2016. - 192 с.

Additional:

1. Голицына, О.Л. Основы алгоритмизации и программирования: Учебное пособие / О.Л. Голицына, И.И. Попов. - М.: Форум; Издание 2-е, 2015. - 432 с.

2. Черпаков, И. В. Основы программирования. Учебник и практикум / И.В. Черпаков. - М.: Юрайт, 2016. - 220 с.

3. Захарова, И.Г. Информационные технологии в образовании: / И.Г. Захарова. - М.: Academia, 2016. - 543 с.

4. Цветкова М.С. Информационная активность педагогов [Текст] / М.С. Цветкова. - М.: БИНОМ. Лаборатория знаний, 2015. – 352 с: ил.

5. Шарипов Ф.В., Ушаков В.Д. Педагогические технологии дистанционного обучения. Учебное пособие Издательство: Университетская книга, 2016 г.304с.

6. Бурда А. Г. Основы научно-исследовательской деятельности: учеб. пособие (курс лекций) / А. Г. Бурда; Кубан. гос. аграр. ун-т. – Краснодар,2015. – 145 с.

7. Назмутдинов В.Я., Яруллин И.Ф. Управленческая деятельность и менеджмент в системе образования личности. – Казань: ТРИ «Школа», 2013. – 360 с.

8. Дэвид М. Харрис и Сара Л. Харрис Цифровая схемотехника и архитектура компьютера. Второе издание. Издательство: Morgan Kaufman, 2018

9. Кузнецов, С. Д. Основы баз данных / С.Д. Кузнецов. - М.: Бином. Лаборатория знаний, Интернет-университет информационных технологий, 2017. - 488 с.

10. Параллельные методы и алгоритмы [Электронный ресурс]: учебное пособие/ А.В. Волосова – М.: МАДИ, Электронные текстовые и графические данные (5,35 Мбайт). 2020.

11. Габасов Р.Ф., Кириллова Ф.М. Основы динамического программирования. 2019 -264 стр.