

AL-FARABI KAZAKH NATIONAL UNIVERSITY

APPROVED

Vice Rector for Academic Affairs

Khikmetov A.K.

"__" _____ 2020

**ENTRANCE EXAMINATION PROGRAM
FOR APPLICANTS TO PhD IN THE SPECIALTY OF
8D06103 - COMPUTER SCIENCE**

Almaty 2020

The program is compiled in accordance with the State educational standard in the educational program "8D06103-Computer Science. The program was compiled by PhD Imankulov T.S.

The program was considered at a meeting of the Computer Science Department
Minutes No. 31 dated April 15, 2020

Head of Department _____ Imankulov T.S.

Approved at a meeting by the Bureau of the Faculty of Information Technology
Minutes No. 8 dated April 21, 2020

Chairman of Method Bureau _____ Gusmanova F.R.

Approved at a meeting of the Academic Council of the faculty
Minutes No. 21 dated April 24, 2020

Chairman of the Scientific Council
Dean of the faculty _____ Urmashev B.A.

Scientific Secretary _____ Sambetbaeva A.

THE MAINTENANCE

1. The purposes and problems of specialty entrance examination

1.1. The purpose of specialty entrance examination

Entrance qualification examination in the specialty «8D06103 - Computer science» is a form of entrance control to enroll in doctoral studies PhD. The purpose of the entrance control - an estimation of quality of vocational training of the expert and revealing at entrants in doctoral studies in a specialty «8D06103 - Computer science» level of scientific and a professional knowledge and skills in the field of computer science (scientific research and scientific survey; design and engineering; industrial-technological; educational).

1.2. Problems of specialty entrance examination

The exam revealed:

- Knowledge of the entrant of the fundamental foundations of computer science and information technology; main achievements and development trends of modern computer science; technologies of professional and scientific activity; knowledge of the main provisions of professional and scientific ethics and their use in work; knowledge of at least one foreign language at the level of fluency in the language of the specialty; knowledge of the basics of pedagogy and psychology; knowledge of the basics of management and the motivation of the scientific activities of the team.

- Ability to find, analyze and process scientific, technical, natural science and general scientific information, leading it to a problem-task form; publicly present their own new scientific results; to design and carry out their professional, scientific and scientific-pedagogical activities, as well as the activities of the team; be able to conduct joint scientific activities; to design your further professional development.

- Skills of independent research work and research work, as well as activities within the group; scientific project activities, the solution of standard scientific and professional tasks, the correct and logical design of their thoughts in oral and written form, the teaching of computer science in secondary specialized and higher educational institutions.

2. Requirements to level of preparation of the entrants entering doctoral PhD

The entrant who entering in doctoral PhD in a specialty «8D06103 - Computer science», should have fundamental scientific and professional training, know the modern technologies, including methods for obtaining, processing and storing scientific information, be able to formulate and solve modern scientific and practical problems, to plan and to conduct scientifically-research/experimentally-research activity on the selected scientific specialty. It is desirable to have experience of teaching in high schools, successfully to carry out research and administrative activity. To own a foreign language, presence of the international certificate is welcomed.

3. Prerequisites of educational program

- Advanced Data Structures, Algorithms and Analysis;
- Technology of Software Development.

4. THE LIST OF EXAMINATION THEMES

Discipline «Network Technologies»

1. Technology local and global networks. Overview and brief description of local area network technologies (Ethernet, ARCnet, Token Ring, Token Bus, TCNS, 100 Base VG, 100 Base VG-Any LAN, CDDI/TPDDI). Advantage of Ethernet technology over other network technologies. Classification of global network technologies. Overview and brief description of global network technologies (X. 25, Frame Relay, ISDN, FDDI, PDH, SONET/SDH, ATM, xDSL).

2. Technologies multi-service access. Integrated voice and data transmission. Wireless technology. Digital subscriber channels., Cable access technologies. Introduction to optical network technologies. Technologies for transmitting voice data over the IP Protocol. Technologies and standards for organizing video conferences.

3. Bridges, switches, gateways. Transparent bridge connections. Bridge connection of heterogeneous networks. Bridge routing from source. Gateways Switched LANs and VLANs. Virtual Private Networks VPN. Switching in ATM mode. MPLS switching. DLSw technology.

4. Routing Routing methods. Overview and summary of routing protocols.

5. Network management. Network Protection Technologies. Network directories. Network Caching Technologies Networks for storing information. IBM Network Management. Remote monitoring. SNMP protocol. Quality of service.

The list of the recommended literature

Basic

1. Cisco Systemsjnc. Руководство по технологиям объединенных сетей, 4-е издание.: Пер. с англ. - М.: Издательский дом «Вильямс» ,2005.-1040 с.:ил.

2. Компьютерные сети. Принципы, технологии, протоколы /В.Г. Олифер, Н.А.Олифер. - СПб: Издательство «Питер», 2006.-958с.:ил.

3. Э. Таненбаум. Компьютерные сети. - СПб.: Издательство «Питер», 2009.- 992с. :ил.

Additional

1. Криста Андэрсон с Марком Минаси. Локальные сети. Полное руководство: Пер. с англ. - К.: ВЕК+, М.: ЭНТРОП, СПб: КОРОНА принт, 1999.-624 с.:ил.

2. Microsoft Corporation. Компьютерные сети. Учебный курс: Официальное пособие Microsoft для самостоятельной подготовки: Пер. с англ. - 2-е изд., испр. и доп.- М.: Издательско-торговый дом «Русская редакция», 1999.-576 с.:ил.

3. Оглтри, Терри. Модернизация и ремонт сетей, - 2-е изд.: Пер. с англ.: Уч.пос- М.: Издательский дом «Вильямс», 2000.-928 с.:ил.

4. Центр справки и поддержки Windows XP.

5. Microsoft Windows 2000 Server. Энциклопедия пользователя: Пер. с англ./Тод Браун - К.: Идательство «ДиаСофт», 2001.

6. Нортон П., Мюллер Д. Полное руководство по Microsoft Windows XP. Пер. с англ. - М.: ДМК Пресс, 2002. - 736с. :ил.

7. Современные компьютерные сети. 2-е изд./В.Столлингс. - СПб.: Издательство «Питер», 2003. - 783с. :ил.

Discipline «Technology of Software Development»

1. The process of software development. Overview of modern software development technologies. Organization of the software development process. Managing project. Identify and reduce risks. Development and support tools.

2. Requirements and software architecture. Requirements analysis. A description of the requirements. Adding detailed requirements. Software architecture. Types of architectures and their models.

3. The design of software systems. Fundamentals of software system design. Features of the software system synthesis process. Features of the design stage. Classical design methods.

4. Testing of the software supply. Principles of software testing. Structural software testing. Functional testing of software. The organization of the process of software testing. Methodology for testing software systems. System testing.

5. Object-oriented software systems. Development of the user interface of various software systems and requirements for interface design. Fundamentals of object-oriented representation of software systems. The basis of the visual modeling language. Static models of object-oriented software systems. Dynamic models of object-oriented software systems. Implementation models for object-oriented software systems. Metrics for object-oriented software systems. Unified development process for object-oriented software systems.

The list of the recommended literature

Basic

1. Орлов С.А. Технологии разработки программного обеспечения. СПб.: Питер, 2002. 464с.
2. Кокарева Е.В., Гагарина Л.Г., Виснадул Б.Д, Технологии разработки программного обеспечения. ИНФРА-М, издательский дом Форум, 2008г.
3. Брауде Э. Технологии разработки программного обеспечения. СПб.: Питер, 2004.
4. Сергушичева А.П. Технология разработки программного обеспечения: Методические указания к выполнению лабораторной работы №4 «Применение CASE-средств при разработке программного обеспечения». – Вологда: ВоГТУ, 2007.

Additional

1. Орлов С.А. Принципы объектно-ориентированного и параллельного программирования на языке Ада95. Рига: TSI, 2001.
2. Ambler S.W. The object Primer. 2nd ed. Cambridge University Press, 2001.
3. Beck K., Fowler M. Planning Extreme Programming. Addison-Wesley, 2001.
4. Bohm D.W. et al. Software Cost Estimation with Cocomo II. Prentice Hall, 2001.
5. Cockburn A. Agile Software Development. Addison-Wesley, 2001.
6. Fowler M. The new Methodology <http://www.martinfowler.com>, 2001.

Discipline «Parallel and distributed computing»

1. Overview of parallel programming technology. Basic principles for creating parallel programs. Parallel Computing Models. Hardware Structures. Processors and Cache Memory. Shared memory multiprocessors. Iterative and recursive concurrency.
2. Programming with shared variables. Processes and synchronization. Parallelization of processes. Process synchronization. Locks and barriers. Barrier synchronization. Semaphores. Resource allocation and planning. Monitors.
3. Distributed Programming »Messaging, Asynchronous Messaging. Client Servers Synchronous messaging. Case Studies: CSP, Linda, MPI Library, Java.
4. Remote procedure call and rendezvous. Synchronization in modules. Time server. Caching in a distributed file system. Rendezvous. Examples of client-server interactions.

5. Process interaction models. Manager - workers. Ripple Algorithms. Pipeline Algorithms. Probe-echo algorithms. Mailing algorithms. Token transfer algorithms. Duplicate servers.
6. The implementation of language mechanisms. Asynchronous messaging. Kernel for shared memory. Distributed core Synchronous messaging. Direct interaction using asynchronous messages. Distributed Shared Memory
7. Synchronous parallel programming. Scientific calculations. Grid Computing. Laplace equation. The method of successive iterations of Jacobi. Point calculations. A program with shared variables. Approximate methods. Matrix calculations. Gauss method.

The list of the recommended literature

1. Корнеев В. Д. Параллельное программирование в MPI. Издательство «Регулярная и хаотическая динамика» 2003.- 303 с.
2. Воеводин В.В., Воеводин Вл. В. Параллельные вычисления. - СПб: BHV, 2002.
3. Грегори Р. Эндрюс. Основы многопоточного, параллельного и распределенного программирования. Издательство «Вильямс», 2003. - 512 с.
4. Дейкстра Э. Взаимодействие последовательных процессов. - В кн.: Языки программирования. М.: Мир, 1972.
5. С. Седухин. Параллельно-поточная интерпретация метода Гаусса. Вычислительные системы с программируемой структурой (Вычислительные системы, 94). ИМ СОАН СССР. Новосибирск, 1982.
6. Супер ЭВМ. Аппаратная и программная реализация/ Под. Ред. С. Фернбаха: Пер. с. Англ. - М.: Радио и связь, 1991. - 320 с: ил .
7. В. Воеводин. Математические модели и методы в параллельных процессах. М.: Наука, 1986.
8. Д. Росляков, И. Терехов. Новые технологические решения в построении отказоустойчивых систем. Информационные технологии. 1998.
9. <http://www.intuit.ru>. Параллельное программирование. Автор: А.Б. Барский.
10. <http://www.exelenz.ru>. Высокопроизводительные вычисления: курс лекций.

Discipline «Advanced Data Structures, Algorithms and Analysis»

1. Algorithms, their analysis and creation. Function growth rate. Addition and their properties.
2. Divide and Conquer Algorithm. Evaluation of addition. Polynomials and their operations. Relations. Binary relations.
3. Concept of function. Counts. Oriented and non-oriented trees. General description of trees.
4. Binary tree
5. Combinatorics and probability. The rules of addition and multiplication. Binomial coefficients and their estimation. Probability and its axioms.
6. Concepts of conditional probability and independence. Probability and Bayes formula. Discrete random variables. The mathematical expectation of a random variable. Dispersion and standard deviation.
7. Geometric and binomial distribution.
8. Sorting Algorithms.
9. Quick sorting. The principle of the sorting algorithm. Analyze the price below.

The list of the recommended literature

Basic

1. Кормен Томас. Алгоритмы: построение и анализ. М.: Вильямс, 2005.
2. Computer Science for advanced level. Ray Bradley. Stansley T. publishers Ltd, 1999.
3. М.Т. Goodrich, R.Tamassia. Data structures and Algorithms in Java., Prentice Hall. 2005. - 695 p.
4. Р.Сейджвик. Фундаментальные алгоритмы на С-СПб: ООО "ДиаСофтЮп", 2003.- 1136 с.
5. S. Baase. Computer Algorithms. Introduction to Design and Analysis. 2nd edition, Prentice Hall. 2001
6. R. L. Graham, D.E. Knuth, O.Patashnik *Concrete Mathematics*, ADD- WESLEY PUBLISH. COMP., 1988
7. J. Hastad Notes for the course advanced algorithms
8. Абрамов С.А. Лекции о сложности алгоритмов, - М.: МЦНМО, 2009.
9. Кузюрин Н.Н., Фомин С.А. Эффективные алгоритмы и сложность вычислений, - М.: МФТИ, 2007.
10. Гудман С, Хидетниемеи С. Введение в разработку и анализ алгоритмов. -М.:Мир, 1981.
11. Шурыгин В.А. Сложностный метод теории алгоритмов. - М.: ЛИБРОКОМ, 2009.

Additional

1. Б.Я.Советов, С.А. Яковлев Моделирование систем. М.Высшая школа, 2007.
2. Д. Андерсон, Дж. Таннехилл, Р.Плетчер Вычислительная гидромеханика и теплообмен, Мир, том 1,21990.
3. Самарский А.А. Численные методы. М., Мир,1991.
4. Мальцев А.И. Алгоритмы и рекурсивные функции. - М.: Наука, 1986.

Response evaluation criteria

The ticket includes 4 questions. Each question for each discipline is estimated at 25%. The total number for 4 questions is 100%.

Rating scale

| | | |
|----|---------|--------------|
| A | 95-100% | Excellent |
| A- | 90-94 | |
| B+ | 85-89 | Good |
| B | 80-84 | |
| B- | 75-79 | |
| C+ | 70-74 | |
| C | 65-69 | Satisfactory |
| C- | 60-64 | |
| D+ | 55-59 | |
| D | 50-54 | |
| F | 0-49 | Failure |

The doctor's answer is rated "**excellent**" when it demonstrates a thorough understanding of the fundamental foundations of computer science, the main achievements and trends in the development of modern computer science, technology of professional and scientific activity.

Be able to clearly, clearly and logically express your thoughts in writing and speaking; to be able to apply the acquired knowledge to solving practical problems; the ability to reason and draw logical conclusions.

The doctor's answer is evaluated as "**good**" when it demonstrates a significant understanding of the fundamental foundations of computer science, the main achievements and trends in the development of modern computer science, technology of professional and scientific activity.

Be able to clearly, clearly and logically express your thoughts in writing and speaking; to be able to apply the acquired knowledge to solving practical problems; the ability to reason and draw logical conclusions.

The doctor's answer is assessed as "**satisfactory**" when the answer indicates a limited understanding of the fundamental foundations of computer science, the main achievements and trends in the development of modern computer science, technology of professional and scientific activity. It is not able to express clearly, clearly and logically its thoughts in writing and oral speech; is able to apply the received knowledge to the decision of practical problems; the ability to reason and draw logical conclusions.

The doctor's answer is assessed as "**failure**" when the answer indicates a complete lack of understanding of the fundamental foundations of computer science, the main achievements and trends in the development of modern computer science, technology of professional and scientific activity. It is not able to express clearly, clearly and logically its thoughts in writing and oral speech; does not know how to apply the acquired knowledge to the solution of practical problems; inability to reason and make logical conclusions.