AL-FARABI KAZAKH NATIONAL UNIVERSITUY

ENTRANCE EXAMINATION PROGRAM
FOR APPLICANTS TO PhD IN THE SPECIALTY OF
8D06102-COMPUTER ENGINEERING

Almaty 2020

The program is compiled in accordance with the State educational standard in the educational program "8D06102-Computer Engineering". The program was compiled by PhD Imaukulov 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.

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THE MAINTENANCE

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1. The purposes and problems of specialty entrance examination

1.1. The purpose of specialty entrance examination

Entrance qualification examination in the specialty «8D06102 - Computer engineering » 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 «8D06102 - Computer engineering», level of scientific and a professional knowledge and skills in the field of computer engineering (scientific research and scientific survey; design and engineering; industrial-technological; educational).

1.2. Problems of specialty entrance examination

The exam revealed:

- In-depth theoretical and practical preparation in the chosen direction of a science and pedagogical activity;
- Ability to organize and conduct research necessary groundwork for further research in doctoral studies;
- Knowledge of modern technologies in the field of computer engineering;
- Skills of development of technologies in the field of computer engineering;
- Competencies in the field of computer engineering and related areas.

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

The entrant who entering in doctoral PhD in a specialty «8D06102 - Computer engineering», should have fundamental scientific and professional training, know the modern technologies in the field of computer engineering, be able to create and apply modern technologies in the field of computer engineering, 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

- Network Technologies;
- High perfomance computing technology.

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4. THE LIST OF EXAMINATION THEMES

Discipline «Architecture of high-performance system»

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1. Parallel structures of computing systems. Two levels of parallelization. Classification of parallel computing systems. Classification of high-performance systems. Flynn's Taxanomy. Types of multiprocessor systems. Description of the main communication schemes.
2. Methods of intermodule connection (aggregation).
3. Microprocessor systems and parallelization methods.
4. Distributed and shared computing resource of the second level. Crucial fields. Parallelization methods.
5. Parallelization in computing systems at the level of Executive devices. Operation pipelines. Vector pipelines. "Engagement" of vectors. Performing operations on the stack. Generalized

dynamic parallelization procedure in a multi-functional arithmetic and logic unit.

6. Parallel stack processing and static parallelization in the decision field.
7. Ways to organize high-performance processors. Associative processors. Pipeline processors. Matrix processors.
8. Hardware support for the user's language is the main concept of multiprocessor systems. The problem of raising the level of the user's language. Support for type — tagged architecture.
9. Stack mechanism for executing procedures. Processing of arrays.
10. Optimal time schedule for performing work in a multi-functional arithmetic and logic unit.
11. Algorithms for composing" long " command words. Optimized layout of" long " command words.
12. Optimal programming in the control architecture for each clock cycle.
13. Ways to organize high-performance processors. Cellular and DNA processors. Communication processor.
14. Ways to organize high-performance processors. Database processors. Stream processor. Neural processors. Processors with multi-valued (fuzzy) logic.
15. Optimal programming of EPIC-architecture processors.
16. Switches for multiprocessor computing systems. Simple switches.
17. Computing systems of non-traditional architecture. Composite switches. Distributed composite switches.
18. Requirements for a computer system in terms of obtaining an optimal ratio between the required system performance and its cost.
19. Asynchronous computing system based on the principles of "data flow".
20. Concepts of reliability and fault tolerance of computing systems.

The list of the recommended literature

1. Тургунбеков, А. М. Микропроцессорное управление вентильным двигателем в учебно-лабораторном комплексе учеб.пособие. М-во образования и науки РК; ТарГУ им. М.Х. Дулати. - Тараз : 2015. - 227. (jirbis.kaznu.kz - пособие имеется в элект.библ.КазНУ).

2. Тормасов, А. Г. Параллельное программирование многопоточных систем с разделяемой памятью. учеб. Пособие. - М. : Физматкнига, 2014. - 207 с. (jirbis.kaznu.kz - пособие имеется в элект.библ.КазНУ).

3. Баданов, И. К. Микропроцессорное управление шаговым двигателем в учебно-лабораторном комплексе.: учеб. пособие МОиНРК, ТарГУ им. М.Х. Дулати. - Тараз , 2014. - 207 с (jirbis.kaznu.kz - пособие имеется в элект.библ.КазНУ).

4. Степанов А. Архитектура вычислительных систем и компьютерных сетей. ISBN: 9785469014515, Питер СПб., 509с. 2007г.

5. Барский А.Б Применение SPMD-технологии при построении сетевых баз данных с циркулирующей информацией. Информационные технологии, №7, 2004.

6. Барский А.Б., Шилов В.В. Оптимизация ветвления при решении задачи сортировки па процессоре EPIC-архитектуры. Информационные технологии, №1, 2005.

7. Эндрюс Г.Р. Основы многопоточного, параллельного и распределенного программирования. –М.: Вильямс, 2003. -512 с.

8. Антонов А.С. Введение в параллельное вычисления. Методическое пособие. –М.: Изд-во Физического факуьтета МГУ, 2002.-70с.

9. Баденко В.Л. Высокопроизводительные вычисления: учеб.пособие-СПб.: Изд-во Политехн. Ун-та, 2010. -180с.

10. Александр Тормасов. Параллельное программирование многопоточных систем с разделяемой. Издательство: Физматкнига,208с. 2014г.

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 «Вильяме» ,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 «Вильяме», 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 «High-performance computing»

1. Classification of computer systems: shared memory systems, distributed memory systems.
2. Detailing architectures by the achievable degree of parallelism.

3. Models of data transfer networks between processors.
4. Building the efficiency of parallel computers
5. Factors that affect productivity and how to improve it.
6. Methods for developing parallel programs using the MPI message transfer interface.
7. Programming of interacting processes. Asynchronous programming.
8. Coherence of parallel programs. Analysis of the set separation program.
9. Decomposition in problems with data parallelism. Block decomposition taking into account the localization of subareas
10. The problem of compiling parallel programs. Computational models with arrays.
11. Building performance and efficiency estimates for parallel computers.
12. Classification Of M. Flynn.
13. Classification Of T. Feng.
14. Classification Of D. Skillicorn.
15. Petri net.
16. Laws Of Amdala.
17. Gustavson-Barsis Law.
18. GRID concept and metacomputing.

The list of the recommended literature

Basic

1. Воеводин В.В. Параллельные вычисления / В.В. Воеводин, Вл.В. Воеводин. СПб.: БХВ-Петербург, 2002.
2. Гергель В.П., Фурсов В.А. Лекции по параллельным вычислениям: учеб. пособие / В.П. Гергель, В.А.Фурсов. – Самара: Изд-во Самар. гос. аэрокосм. ун-та, 2009. – 164 с.
3. Малышкин В.Э., Корнеев В.Д. Параллельное программирование мультикомпьютеров. - Новосибирск, Новосибирский Государственный технический университет, 2006. - 452 с.
4. Гергель В.П. Теория и практика параллельных вычислений: учеб. пособие/ В.П. Гергель.- М.: Интернет-Университет Информационных технологий; БИНОМ. Лаборатория знаний, 2007. – 423 с.

Additional

1. Тоффоли Т. Машины клеточных автоматов / Т. Тоффоли, Н. Марголус. – М.: Мир, 1991.
2. Keckler, Stephen W., Olukotun, Kunle, Hofstee, H. Peter Multicore Processors and Systems. – Springer Science+Busines Media, LLC 2009.
3. Harold S. Stone High-Performance Computer Architecture. - Addison-Wesley, 1987.

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-средст 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. Cambrige University Press, 2001.
3. Beck K., Fowler M. Planning Extreme Programmong. Addison-Wesley, 2001.
4. Bohm D.W. etal. 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.

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, and the 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, and the 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, and the 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, and the 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.