Ministry of Science and Higher Education of the Russian Federation

Peter the Great St.Petersburg Polytechnic University

Institute of Cybersecurity and Computer Science

APPROVED

Director of ICCS

_____ D.P. Zegzhda

November 28, 2024

PROGRAM

**of entrance examination for applicants to Master's degree program
in the field of study**

09.04.01 Information Science and Computer Engineering

09.04.01_17 Intelligent Systems (International Educational Program)

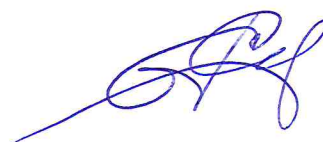*Code and title of field of study and educational program*

St. Petersburg

2024

ANNOTATION

The program of the interdisciplinary entrance exam for the master's degree is based on general professional disciplines implemented in the educational program **09.03.01 "Information Science and Computer Engineering"**. The program contains a list of themes (questions) on disciplines, recommended literature for exam preparation and examples of test tasks.

The entrance test is organized in the form of an interdisciplinary exam in accordance with the requirements of the Russian State Educational Standard of Higher Education. It is held face to face in written form or remotely. The results of the entrance test are evaluated in points. The maximum score is 100. The minimum number of points confirming successful passing of the interdisciplinary exam is 50 points (50%).

Programme director   E.S. Gebel

Author of the Program:

Associate Prof., PhD   V.N. Khoklovskiy
Associate Prof., PhD   R.V. Davydov

Programme was reviewed and recommended for publication by the Academic Council of Cybersecurity and Computer Science (Protocol # 9/24 dated November 28, 2024).

1. DISCIPLINES LIST

1.1. Computer systems, networks and telecommunications
1.2. Operating systems
1.3. Computational Mathematics

2. CONTENT OF ACADEMIC DISCIPLINES

2.1. Computer systems, networks and telecommunications

Themes of the discipline

1. Computer architecture.
2. Central processor unit.
3. Memory device.
4. The system bus, data bus, address bus.
5. Peripheral devices of the computer system.
6. Computer networks: principles and protocols.

Recommended literature

1. Broido V. L. and IlyinaO. P. Computer systems, networks and telecommunications: students book : Peter, 2011. 554 p.
2. Orlov S. A. and TsilkerB. Ya. Organization of computers and systems : students book : St. Petersburg, 2011. 686 p.
3. Kalinkina T. I., Kostrov B. V. and Ruchkin V. N. Telecommunication and computer networks. Architecture, standards and technologies : students book. St. Petersburg : BHV-Petersburg, 2010. 283 p.
4. Khoroshevsky V. G.. Architecture of computer systems : students book. Publishing House of the Bauman Moscow State Technical University, 2008. 519 p.

2.2. Operating system

Themes of discipline

1. Operating-System Structure: Operating-System Services, User and Operating-System Interface, System Calls, System Services, Linkers and Loaders.
2. Process Concept: Process Scheduling, Operations on Processes, Interprocess Communication, IPC in Shared-Memory Systems, IPC in Message-Passing Systems.
3. Threads & Concurrency: Multicore Programming. Multithreading Models. Thread Libraries. Implicit Threading.

4. CPU Scheduling: Scheduling Criteria. Scheduling Algorithms. Thread Scheduling. Multi-Processor Scheduling. Real-Time CPU Scheduling.
5. Synchronization Tools: The Critical-Section Problem. Peterson's Solution. Hardware Support for Synchronization. Mutex Locks. Semaphores. Monitors. Liveness.
6. Deadlocks: Deadlock in Multithreaded Applications. Deadlock Characterization. Methods for Handling Deadlocks. Deadlock Prevention. Deadlock Avoidance. Deadlock Detection. Recovery from Deadlock.
7. Main Memory: Contiguous Memory Allocation. Paging. Structure of the Page Table. Swapping.

Recommended literature

1. Karpov V. E., Konkov K. A. Fundamentals of operating systems. Course of lectures : students book. M. : Internet University of Information Technologies, 2011. 531 p.
2. Petrov A. V., Fedorov S. A. System software GNU/Linux. Basics of the command line : students book; Peter the Great St. Petersburg Polytechnic University. St. Petersburg, 2023.
3. Gordeev A. V. Operating systems : students book. Moscow : Piter, 2009. 415 p.
4. Nazarov S. V. Modern operating systems : students book / S. V. Nazarov, A. I. Shirokov. M. Internet-University of Information Technologies, 2010 : Binom. Laboratory of knowledge. 279 p.
5. Avi Silberschatz, Peter Baer Galvin, Greg Gagne. Operating System Concepts. Tenth Edition. John Wiley & Sons, Inc. ISBN 978-1-118-06333-0

2.3 Computational Mathematics

Themes of discipline

1. Theoretical foundations of numerical methods (Computational errors. Stability and complexity of the algorithm (in memory, in time)).
2. Numerical methods of linear algebra.
3. Numerical methods for solving nonlinear equations and systems.
4. Interpolation of functions.
5. Numerical integration and differentiation.
6. Solution of ordinary differential equations.
7. Methods of approximation and approximation of functions.
8. Fourier transform.
9. Mathematical software systems (introduction to Matlab, MathCad, Maple).

Recommended literature

1. Zhidkov E. N. Computational mathematics : students book. M. Academy, 2010. 199 p.

2. Porshnev S. V. Computational mathematics : a course of lectures. Saint-Petersburg : BHV-Peterburg, 2014. 320 p.
3. Kalitkin N. N. Numerical methods : textbook for universities and universities. Saint-Petersburg : BHV-Peterburg, 2015. P 586 p.
4. Samarsky A. A., Mikhailov A. P. Mathematical modeling. Ideas. Methods. Examples. Moscow : Fizmatlit, 2005. 316 p.
5. Bakhvalov, N. S. Bakhvalov N. S. , Zhidkov N. P., Kobelkov G. M. Numerical methods. Ninth edition. Moscow : Laboratory of Knowledge, 2020. 636 p.

3. SAMPLE QUESTIONS
Peter the Great St. Petersburg Polytechnic University
Institute of Cybersecurity and Computer Science

ENTRANCE EXAMINATION
09.04.01 Informatics and Computer Engineering
09.04.01_17 Intelligent Systems (International Educational Program)

Test consists of 25 questions. The maximum number of points for each question is 4.

Topic "Computer systems, networks and telecommunications"

Sample questions:
1. The property that ensures the use of relative addressing
    a. reduction of time for formation of the executive address
    b. management simplification when forming the executive address
    c. relocation of programs
    d. expansion of addressable physical space

2. The efficiency of direct memory access is determined by
    a. polling quality
    b. elimination of the overflow of bit grid
    c. ability to use tracing
    d. lack of context switching

Topic "Operating Systems"
Sample questions:
1. Operating systems are classified into (choose two or more answers)
    a. single and multi-user
    b. single and multi-tasking
    c. single and multi-layer
    d. applied and targeted

2. The file system is (choose two or more answers)
　　a. coherent set of processes
　　b. software tools, implementing various operations on files
　　c. codes library
　　d. part of the operating system

Topic "Computational Mathematics"
Sample questions:
1. Criteria that allows to choose the best approximation of the table function
　　a. maximum modulus of deviation of the original function from the approximating one on the given interval
　　b. root-mean-square criteria
　　c. criteria is determined by the requirements for the problem being solved
　　d. both methods will provide the best approximation

2. Main disadvantage of numerical differentiation expressions
　　a. problems with the error estimation
　　b. proximity to each other of the original and approximating functions
　　c. high complexity of computer programs
　　d. high complexity of calculating derivatives