NON-PROFIT JOINT-STOCK COMPANY
ALMATY UNIVERSITY OF ENERGY AND COMMUNICATIONS
NAMED AFTER GUMARBEK DAUKEYEV

Approving it

Vice-Rector for Science

K. Alipbayev

"____" _____ 2026 y.

PROGRAM

entrance exam for doctoral studies in the direction of

Engineering and Engineering: D100 "Automation and Control"

Almaty 2026

The program for the D100 "Automation and Management"group of educational programs is compiled on the basis of standard and working curricula, as well as discipline programs.

The program was reviewed and approved at the meeting of the Department of AC protocol №.10 of "4" 05.2026 г.

Head of the AC Department _____ Abzhanova L. K.

The program of the entrance exam for the D100 "Automation and Management" group of educational programs was approved by the educational and methodological Commission of the Institute of Telecommunications and Automation " 15 " 05. 2026. Protocol №. 10.

ITA Director_____ Omarbekova A. O.

The program of the entrance exam for doctoral studies in the D100 "Automation and Control" group of educational programs is approved by the Department of Science of the G. Daukeyev AUES.

Director of the Department of Science _____ Kalieva N. B.

The program of the entrance exam for doctoral studies in the D100 group of educational programs "Automation and Management" is approved by the Department of Academic Affairs of the G. Daukeyev AUES.

Director of the AQ Department_____ Baizakova S. M.

I. General provisions

1. The program is drawn up in accordance with theOrder of the Minister of Education and Science of the Republic of Kazakhstan dated October 31, 2018 No. 600 "On Approval of the Standard Rules for Admission to Study in Educational Organizations implementing educational programs of higher and Postgraduate education" (hereinafter referred to as the Standard Rules), taking into account the amendments and additions made.

2. The entrance exam for doctoral studies includes an interview, essay writing, and an exam on the profile of a group of educational programs.

Block	The Points
1 block. Interview	30
2. Essay	20
3. Exam on the profile of the group of the educational program	50
Total/pass	100/75

3. The duration of the entrance exam is 3 hours and 10 minutes, during which the applicant writes an essay, answers an electronic exam card. The interview is conducted on the basis of the university before the entrance exam.

II. Procedure for conducting the entrance exam

1. Applicants to the doctoral program group D100 "Automation and Management" write a problem / thematic essay. The essay should be at least 250 words long.

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

Types of essays:

- motivational essay with the disclosure of motivating motives for research activities;
- scientific and analytical essay with justification of the relevance and methodology of the planned research;
- problem / thematic essay that reflects various aspects of scientific knowledge in the subject area.

2. The electronic exam card consists of 3 questions.

Obsession

1. Modern problems of management of technical and technological processes 5
2. Application of artificial intelligence in automation tasks 6
3. Methods of synthesis and analysis of modern automatic control systems 7
4. Current state of design of automatic control systems 8

1 MODERN PROBLEMS OF MANAGEMENT OF TECHNICAL AND TECHNOLOGICAL PROCESSES

Topic 1 Modern data transfer technologies in automated process control systems

Modern technologies for data transfer between automated process control system elements. Industrial interfaces and data transfer protocols. Features of building distributed control systems.

Topic 2 Automated process control system software and hardware complexes

Structural construction of software and hardware complexes. Modern principles of building automated process control systems. Architecture of modern SCADA systems and distributed control systems.

Topic 3 Industrial networks and controllers

Modern technologies of industrial networks for connecting industrial controllers. Structural construction of industrial networks. Industrial Ethernet networks and smart devices.

Topic 4 Modern software systems for industrial network design

Modern software tools for designing industrial networks and automation systems. Integration of software systems into the automated process control system. Prospects for the development of digital technologies in industrial automation.

LIST OF RECOMMENDED LITERATURE

Basic literature

1. Titaev A. A. Promyshlennye seti: uchebnoe posobie [Industrial networks: a textbook]. Yekaterinburg: Ural State University Press, 2020, 124 p. (in Russian)

2. Elizarov I. A., Nazarov V. N., Pogonin V. A., Tretyakov A. A. Promyshlennye vychislitel'nye seti: uchebnoe posobie [Industrial computing networks: a textbook]. Tambov: TSTU Publ., 2018, 164 p. (in Russian)

3. Kangin V. V., Kozlov V. N. Hardware and software management systems. Industrial networks and controllers. Moscow: Binom Publ., 2013, 418 p. (in Russian)

4. Petrov I. V. Programmable controllers. Standard languages and techniques of applied design. - Moscow: SOLON-Press, 2014. - 256s.

5. Bolton W. Programmable Logic Controllers. – 6th ed. – Newnes, 2015. – 376 p.

Additional literature

1. Demenkov N. P. Programming and configuration of industrial networks. Moscow: Bauman Moscow State Technical University, 2010, 238 p.

2. Zimin V. V. Promyshlennye seti [Industrial networks]. Nizhny Novgorod: NSTU Publ., 2006, 198 p.

3. Kopesbaeva A. A. Microprocessor complexes in control systems. Almaty: AUES Publ., 2010, 210 p. (in Russian)

2 APPLICATION OF ARTIFICIAL INTELLIGENCE IN AUTOMATION TASKS

Topic 1 Expert systems in automation

Purpose and properties of expert systems. Structure of the expert system. Static and dynamic expert systems. Knowledge bases and methods of knowledge representation. Application of expert systems in process automation.

Topic 2 Fuzzy intelligent control systems

Basics of fuzzy logic and fuzzy sets. Architecture of fuzzy control systems. Fuzzy inference algorithms by Mamdani, Sugeno, Tsukamoto, and Larsen. Application of fuzzy systems in automation.

Topic 3 Artificial neural networks

Classification and architecture of neural networks. Activation functions and learning algorithms. Method of back propagation of an error. Kohonen, Hopfield, Elman, and Jordan neural networks and RBF networks. Application of neural networks in automation and control tasks.

Topic 4 Genetic algorithms

Principles of operation of genetic algorithms. Information representation and genetic operators. Selection, crossing-over, mutation, and inversion operators. Application of genetic algorithms in optimization problems.

Topic 5 Modern intelligent technologies in automation

Key AI technologies in automation. SCADA systems, cloud technologies, and the Internet of Things (IoT). Intelligent control systems and the use of artificial intelligence in industrial automation.

LIST OF RECOMMENDED LITERATURE

Basic literature

1. Zabolotnova E. Y. Expert systems: educational and methodical manual. Kaliningrad : KSTU Publ., 2022, 95 p. (in Russian)
2. Expert systems : a textbook. – Minsk, 2020. - 140 p.
3. Veselov O. V. Fuzzy logic and neural networks in control systems and diagnostics : a textbook. - Vladimir : VlSU, 2023. - 156c.
4. Suleimenov B. A., Omirbekova Zh.Zh., Suleimenov A. B. Intelligent control systems for technological processes. Almaty:KazNSTU named after K. I. Satpayev,2017.-388 p.

Additional literature

1. Modern tools used in the formation of intelligent control systems / / CyberLeninka. - 2025
2. Integrating Artificial Intelligence into Mechatronics // Technologies. – 2026.
3. Intelligence: Intelligence. Volume 1. - Almaty, 2022.
4. Intelligence: Intelligence. Volume 2. - Almaty, *2022*

3 METHODS OF SYNTHESIS AND ANALYSIS OF MODERN AUTOMATIC CONTROL SYSTEMS

Topic 1 Nonlinear and bilinear automatic control systems

Mathematical description of nonlinear and bilinear control systems. Types of nonlinearities in automatic control systems. Methods of analysis of nonlinear systems. Linearization of nonlinear systems. Lyapunov stability study of nonlinear systems.

Topic 2 Invariant and robust control systems

The concept of invariance of control systems. Principles of construction of invariant systems. Robustness of control systems under parametric uncertainty and external influences. Criteria for robust stability. Methods of synthesis of robust control systems.

Topic 3 Optimal automatic control systems

Formulation of optimal control problems. Criteria for optimal control systems. Pontryagin's maximum principle. Methods of dynamic programming.

Topic 4 Adaptive automatic control systems

Principles of building adaptive control systems. Systems with self-tuning parameters. Methods for identifying parameters of control objects. Systems with a template model.

LIST OF RECOMMENDED LITERATURE

Basic literature

1. Pupkov K. A., Egupov N. D. Metody robustnogo, neuro-nezhetkogo i adaptivnogo upravleniya [Methods of robust, neuro-fuzzy and adaptive control]. Moscow: Bauman Moscow State Technical University Publishing House, 2002, 744 p.
2. Methods of classical and modern automatic control theory. Volume 5: Methods of modern automatic control theory / Edited by K. A. Pupkov and N. D. Egupov, Moscow: Bauman Moscow State Technical University Publishing House, 2004, 784 p.
3. Kim D. P. Teoriya avtomaticheskogo upravleniya [Theory of automatic control], vol. 2. Multidimensional, nonlinear, optimal and adaptive systems. Moscow: FIZMATLIT PUBL., 2004, 464 p.
4. Khalil H.K. Nonlinear Systems. – 3rd Edition. – New Jersey: Prentice Hall, 2002. – 750 p.

Additional literature

1. Altunin A. E., Semukhin M. V. Models and algorithms of decision making in fuzzy conditions. Tyumen: Tyumen State University Press, 2000, 352 p. (in Russian)
2. Slotine J.-J.E., Li W. Applied Nonlinear Control. – New Jersey: Prentice Hall, 1991. – 461 p.

4 CURRENT STATE OF DESIGN OF AUTOMATIC CONTROL SYSTEMS

Topic 1 Automation of life cycle stages of automatic control systems

Automation of all stages of the production life cycle of automated object management systems. Modern approaches to the design of automation systems. Integration of digital technologies in the design and operation of control systems.

Topic 2 CAD design principles and classification

Principles of creating CAD structures and technologies. Classification of modern computer-aided design systems. Comparative analysis of modern CAD systems in the field of automation and control.

Topic 3 Structure and architecture of modern CAD systems

Typical CAD structure of electric power systems and its place among other automation systems. Architecture of modern computer-aided design software systems. CAD information support.

Topic 4 Methods of computer-aided design of a structure and technological process at various levels of the hierarchy.

Mathematical models (MM) at various hierarchical levels. Mathematical models of the design objects of the SA RES. Mathematical models of SA RES at the meta-level. Automated synthesis of digital devices.

LIST OF RECOMMENDED LITERATURE

Basic literature

1. A. M. Afonin [et al.]. Teoreticheskie osnovy razrabotki i modelirovaniya sistem avtomatizatsii : ucheb [Theoretical foundations of development and modeling of automation systems]. manual / - Moscow: INFRA-M, 2021. - 191 p.

2. Karpenko A. P. Osnovy avtomatizirovannogo proektirovaniya Uchebnik [Fundamentals of computer-aided design], Moscow: INFRA-M, 2014, 326 p. + Additional materials. http://www.znanium.com].

3. I. A. Yelizarov, Yu. F. Martemyanov, and A. G. Skhirtladze. Technical means of automation. Software and hardware complexes and controllers: textbook. stipend / - Stary Oskol : TNT, 2021. - 236 p.

4. Utepbergenov I. T., Sagyndykova Sh. N. Methods and models of CAD of automation systems in fuel and energy sector. Almaty: AUES Publ., 2017.

Additional literature

1. Utepbergenov I. T., Sagyndykova Sh. N. Methods and models of CAD of automation systems in fuel and energy sector. Guidelines for laboratory work. Almaty: AUES Publ., 2017.

2. Утепбергенов И.Т., Сагындыкова Ш.Н. Ақпараттық жүйелердегі деректер қоры. Almaty: AUES Publ., 2016.

3. R. Z. Pen, V. R. Pen. Statistical methods of mathematical modeling, analysis and optimization of technological processes: textbook. manual /. - 2nd ed., ster. - St. Petersburg: Lan, 2021. - 308 p.