JSC "ALT University named after Mukhamedjan Tynyshpayev"

APPROVED
Chairperson of the Academic Council of "ALT University"
_____ M.S. Zharmagambetova
Decision of the Academic Council of "ALT University"
"__" ___ 2026 (Minutes No. __)

PROGRAM OF THE ENTRANCE EXAM FOR DOCTORAL STUDIES IN THE ROFILE FIELD

8D06257 — **"Radio Engineering, Electronics and Telecommunications" (profile-based)**

D096 — **"Communications and communication technologies"**

Almaty, 2026

The program of the entrance examination was discussed and received a positive decision at the meeting of the Department of Radio Engineering and Telecommunications, Protocol . No. 7 dated "10" March 2026.

Head of the RT Department _____ **G.D. Musapirova**

The program of the entrance examination was reviewed and recommended at the meeting of the Council of the Institute of Energy and Digital Technologies, Protocol No. 8 dated March 19, 2026.

Chairperson of the Council of the "EaDT" Institute **A.Zh. Toygozhynova**

CONTENTS

1. PURPOSE OF THE ENTRANCE EXAMINATION

The purpose of the entrance examination is to determine the level of theoretical and practical preparedness of applicants for doctoral studies and to assess the compliance of their knowledge, skills, and abilities with the requirements of the chosen field of study.

The entrance examination for the Doctor of Philosophy (PhD) program consists of the following components:

1)an interview with the applicant conducted by the examination committee;

2)answers to examination questions in the profile of the educational program group;

3)the availability of a recommendation letter from an enterprise or organization.

2. FORMAT AND PROCEDURE FOR CONDUCTING THE ENTRANCE EXAMINATION

The duration of the entrance examination is 2 hours 30 minutes, during which the applicant undergoes an interview and answers an electronic examination ticket consisting of 3 questions. The list of questions is generated in random order. The maximum score for the entrance examination is 80 points, including: examination in the profile of the educational program group – 50 points; interview – 30 points.

3. TYPES AND ASSESSMENT CRITERIA

3.1 Criteria for evaluating answers to the electronic examination ticket questions

The examination in the profile of the educational program group includes **three blocks of questions**, where: the first question assesses the level and systematization of theoretical knowledge; the second question evaluates the level of developed functional competencies; the third question is aimed at assessing systemic competencies. The maximum score is **50 points**.

The electronic examination ticket consists of **3 questions**.

Blocks	Type of question	Number of points
1st question	Theoretical – determines the level and systematization of theoretical knowledge	10
2nd question	Practical – identifies the level of developed functional competencies (ability to apply methods, technologies, and techniques in the subject area)	20
3rd question	Assesses systemic understanding of the studied subject area, specialized knowledge in research methodology (systemic competencies)	20
TOTAL		**50**

Criteria for assessing answers to the questions in the electronic examination ticket:

Question	Assessment Criteria	Points
Question 1	Demonstrates knowledge of the fundamental processes in the relevant subject area; provides a comprehensive and in-depth answer.	5
	Expresses personal opinions on the discussed issue logically and consistently.	3
	Demonstrates proficiency in the conceptual and categorical framework and scientific terminology.	2
	Total	**10**
Question 2	Applies appropriate methods, techniques, and technologies to solve problems in the subject area.	7
	Justifies, compares, and classifies phenomena, events, and processes; draws conclusions and makes generalizations based on practical skills.	7
	Analyzes information obtained from various sources.	6
	Total	**20**
Question 3	Critically analyzes and evaluates theoretical and practical developments, scientific concepts, and current trends in the development of science.	7
	Synthesizes methodological approaches in interpreting the key issues of the subject area.	7
	Identifies cause-and-effect relationships in the analysis of processes, phenomena, and events.	6
	Total	**20**
	GRAND TOTAL	**50 баллов**

3.2 Criteria for Interview Assessment

№	Criteria	Descriptors	Points
1.	**Motivation**	Provides justification of motivation for doctoral studies in the chosen educational program and for admission to a specific university. Demonstrates vision of professional and personal development after completion of studies.	5
2	**Research competence**	Demonstrates research skills and experience required for scientific research activities in the relevant subject area.	10
3.	**Creativity**	Shows non-standard thinking, creative and alternative approaches to solving problems and situational tasks.	10
4.	**Communication skills**	Able to present ideas briefly, clearly, logically, and convincingly; makes generalizations and conclusions. Demonstrates language proficiency.	5
Maximum score			**30**

3.3 Recommendation Letter from an Enterprise or Organization

For admission to doctoral studies in the profile field, the recommendation letter from an enterprise or organization must be prepared on official letterhead, contain specific details, and confirm the company's interest in supporting the applicant's studies.

4. CONTENT OF EXAMINATION MATERIALS

4.1 Content of thematic sections included in the entrance examination

Examination materials for the entrance examinations to doctoral studies by groups of educational programs, as well as examination questions in the profile, are prepared in three languages: Kazakh, Russian, and English.

The topics of the examination questions correspond to selected sections from the curricula of the cycles provided for the group of educational programs D096 – Communications and Communication Technologies.

№	Name of disciplines
1	Design and Technical Operation of Optical Fiber Transmission Systems (OFCS)
2	Scientific Foundations of Modeling in Infocommunication Technologies
3	Mobile Multichannel GSM Standard Technologies

4.2 Content of thematic sections included in the entrance examination

Block 1

1.1 Measurements in telecommunication systems

Basic concepts and terminology. Types and methods of measurements. Classification of measuring instruments. Traceability (unity) of measurements. Classification of measurement technologies in modern telecommunications. System and operational equipment. Measurement errors and processing of measurement results. Systematic error. Classification of measurement technologies in modern telecommunications. Measurement of voltage and current. Analysis of signal waveform and parameters. Measurement of signal spectra.

1.2 Measurement technologies in modern telecommunications

Information model of a measurement system. Single and multiple measurements, their errors, and presentation of measurement results. Bit errors and their impact on digital transmission parameters. Spectrum analysis of signals. Mathematical expectation, variance, and standard deviation of measurement results. Indirect measurements and their errors. Direct unequal-precision measurements. Measurement technologies in SDH and PDH systems. Measurement equipment for operational testing of communication systems. Optical time-domain reflectometer (OTDR) based on backscattering. Measurement of key parameters of optical fiber transmission lines (OFCS). Methods and tools for measuring transmission parameters in WDM systems.

Block 2

2.1 General principles of experiment theory and engineering

Introduction to experiment theory in radio electronics and telecommunications (RET). Main stages of experiment planning in RET. Methods of experimental data processing. Methodologies of experimental research. Measurement and analysis of electrical signal parameters. Experimental methods for measuring signal frequency and period. Experiments

with antennas and radio wave propagation. Experimental studies of radio-frequency devices. Experiments on signal modulation and demodulation. Experimental studies of digital communication systems.

2.2 Experimental works in RET

Experiments with microcontrollers and programming in RET. Experimental studies of radio-frequency and microwave emitters. Experiments with sensors and transducers in RET. Experiments with ultra-high-frequency devices and optical systems. Experiments using Internet of Things (IoT) technologies in RET. Experiments using blockchain technologies in RET.

Block 3

3.1 Technologies and standards of mobile systems

General provisions. Structural diagram of the transmission channel. Application of DWDM systems. Digital methods of information transmission. Fundamentals of a systems approach to the design of systems and transmission lines. Reliability indicators of non-repairable objects. Reliability indicators of repairable objects. Formulation of the optimization problem. Optimization methods. General principles of standardization. Basic definitions. Key standardized performance indicators of digital channels and transmission paths. Calculation of the regeneration section length of digital transmission systems (DTS) over electrical cables. Calculation of sections of optical fiber transmission lines.

3.2 EMC and mobile communication systems

Design features of fiber-optic transmission lines (FOTL) based on Synchronous Digital Hierarchy (SDH). Organization of technical maintenance processes. Organization of technical maintenance and management systems. Purpose and interaction of control stations in the operation of analog and digital transmission systems (PDH). Measurements in the operation of digital transmission systems (DTS). General provisions. Operating modes of network time synchronization. General principles of building a time synchronization network (TSN). Synchronization in SDH networks. Optimization of the preventive maintenance (PM) period by minimizing the downtime coefficient. Optimization of the PM period by minimizing costs. Operational standards for error parameters in SDH transmission paths. Certification of PDH digital transmission systems. Certification of SDH digital transmission systems. Certification of optical fiber transmission systems. Local Automatic Exchange (LAX). General provisions on maintaining production documentation.

4.3 List of questions

1. What are the current scientific and technological challenges facing the field of radio engineering, electronics, and telecommunications?
2. What is the scientific novelty of your proposed research, and what practical problem will it help to solve?
3. Which global trends in the development of telecommunications technologies have the greatest impact on the industry?
4. What are the prospects for implementing artificial intelligence and machine learning technologies in radio engineering and telecommunications systems?
5. What modern digital signal processing methods are used to improve the quality of information transmission?
6. What methods for improving the spectral and energy efficiency of wireless networks are the most promising?
7. What are the advantages and limitations of software-defined radio (SDR) and network function virtualization (NFV) technologies?

8. What tasks are solved by intelligent antenna systems and MIMO technologies in modern communication networks?
9. How can electromagnetic compatibility of radio-electronic equipment be ensured in conditions of high device density?
10. What modern methods of improving noise immunity are used in telecommunication systems?
11. What technologies are used to ensure information security in modern communication networks?
12. What are the prospects for the development of satellite communication systems and their integration with terrestrial telecommunication networks?
13. Which scientific research methods are most effective for modeling and analyzing telecommunication systems?
14. Which indicators are used to evaluate the efficiency and performance of telecommunication networks?
15. What are the main development directions of sixth-generation (6G) communication networks, and what scientific challenges must be solved for their implementation?
16. What prospects do quantum communications and quantum cryptography have in the development of secure communication networks?
17. What modern software tools and simulation packages are used in the study of radio engineering and telecommunication systems?
18. Which research areas in the Internet of Things (IoT), Industrial IoT (IIoT), and intelligent transport systems are currently the most relevant?
19. Which publications, scientific projects, or research results demonstrate your readiness to carry out a doctoral dissertation?
20. How do you see the prospects for the development of radio engineering, electronics, and telecommunications in the Republic of Kazakhstan, and what scientific research could contribute to the development of domestic science and high-tech industry?
21. What modern approaches are used to build self-organizing and self-managing telecommunication networks (SON)?
22. What methods and technologies are used to increase the capacity of optical and wireless communication channels under conditions of growing traffic demand?
23. What are the modern approaches to integrating heterogeneous networks (5G/6G, Wi-Fi, satellite, and optical networks) into a unified telecommunications infrastructure?
24. •What are the main challenges in scaling communication networks under massive device connectivity conditions, and how are they addressed?
25. What are the promising directions for the development of digital twins in the design and operation of telecommunication systems?

5. RECOMMENDED LITERATURE

5.1 Basic literature

1. "Digital Transmission Systems" Ivanov A.A., Ospanova N.A. Almaty: KazATC, 2012.
2. Fiber-Optic Technology: Current State and Prospects. Dmitriev S.A., Slepov N.N. Moscow, OOO "VOT", 2015.
3. Fiber-Optic Networks and Communication Systems. Sklyarov O.K. St. Petersburg: Lan, 2010.
4. WDM Technology and Testing Guide. André Girard. Moscow: EXPO, 2011.

5. Design and Technical Operation of Digital Telecommunication Systems and Networks. Textbook for universities / E.B. Alekseev, V.N. Gordienko, V.V. Krukhmalev et al.; Edited by V.N. Gordienko and M.S. Tveretsky. Moscow: Hotline–Telecom, 2012. – 392 p.
6. Ryzhikov Yu.I. Simulation Modeling: Theory and Technology. St. Petersburg: KORONA print; Moscow: Alteks-A, 2014. – 384 p.
7. Sovetov B.Ya., Yakovlev S.A. Systems Modeling. Moscow: Higher School, 2015. – 271 p.
8. Kuzmichev D.A., Radkevich I.A., Smirnov A.D. Automation of Experimental Research. Moscow, 2013.
9. "Digital Transmission Systems" Ivanov A.A., Ospanova N.A. Almaty: KazATC, 2012.
10. Fiber-Optic Technology: Current State and Prospects. Dmitriev S.A., Slepov N.N. Moscow, OOO "VOT", 2015.
11. Shtykov V.V. Introduction to Radio Electronics. 2nd ed. Moscow: Yurait, 2025.
12. Erik Dahlman, Stefan Parkvall, Johan Sköld. *5G NR: The Next Generation Wireless Access Technology*, 2nd Edition. Academic Press, 2024.
13. Design and Technical Operation of Digital Telecommunication Systems and Networks. Textbook for universities / E.B. Alekseev, V.N. Gordienko, V.V. Krukhmalev et al.; Edited by V.N. Gordienko and M.S. Tveretsky. Moscow: Hotline–Telecom, 2012. – 392 p.
14. Ryzhikov Yu.I. Simulation Modeling: Theory and Technology. St. Petersburg: KORONA print; Moscow: Alteks-A, 2014. – 384 p.
15. Sovetov B.Ya., Yakovlev S.A. Systems Modeling. Moscow: Higher School, 2015. – 271 p.
16. Kuzmichev D.A., Radkevich I.A., Smirnov A.D. Automation of Experimental Research. Moscow, 2013.
17. Stupin Yu.V. Methods of Computer-Based Automation of Physical Experiments and Installations. Moscow, 2013.

5.2 Additional literature

1. Lipskaya M.A., Mamilov B.E., Zaltsman Yu.M. Methodological Guidelines for Practical Classes prepared in accordance with the curriculum of the discipline "Digital Transmission Systems" for master's students of specialty 6M071900 – Radio Engineering, Electronics and Telecommunications. Almaty, KazATC, 2017.
2. Lipskaya M.A., Zaltsman Yu.M. Methodological Guidelines for Independent Work under the Guidance of an Instructor prepared in accordance with the curriculum of the discipline "Digital Transmission Systems" for master's students of specialty 6M071900 – Radio Engineering, Electronics and Telecommunications. Almaty, KazATC, 2017.
3. Brenny S. Synchronization of Digital Communication Networks. Moscow: Mir, 2013.
4. Biryukov N.L., Triska N.R. Network Synchronization: Interaction Scenarios. *Networks and Telecommunications*, No. 08–09, 2015.