«Mukhametzhan Tynyshbayev ALT University» JSC

I APPROVE
Chairman of the «ALT University» JSC
_____ M.S.Zharmagambetova

Decision of the Academic Council of
«ALT University» JSC
from "30" 05 2025 year (Protocol № 10 )

# PROGRAM
# THE ENTRANCE EXAM TO THE DOCTORAL (PROFILE) PROGRAM

## Group of educational programs
## ""D099 - Power Engineering and Electrical Engineering""

Almaty, 2025

The program of the entrance exam was discussed and received a positive decision at the meeting of the Department of Power Engineering, Protocol No. 8 on April 16, 2025.

**Head of the department of "Power Engineering"** **Egzekova A.T.**

The program of the entrance exam was reviewed and recommended at the meeting of the Council of the Institute of Energy and Digital Technologies, Protocol No. 5 dated April 25, 2025.

**Chairman of the Board of the Institute "EiCT"** **Toygozhinova A.Zh.**

CONTENT

## 1. The purpose of the entrance exam for a group of educational programs

The objectives of the entrance examination for groups of educational programs are to assess the theoretical and practical readiness of applicants for doctoral studies, as well as the level of their knowledge, skills, and competencies in accordance with the requirements of the chosen field of study.

The doctoral entrance examination consists of an interview and an exam on the profile of the educational program group.

## 2. Regulations for conducting the entrance exam for doctoral studies in a group of educational programs

The duration of the entrance examination is 2 hours and 30 minutes, during which the applicant answers an electronic exam ticket consisting of 3 questions. The list of questions is generated randomly. The maximum score for the entrance examination is 80 points, distributed as follows: exam on the profile of the educational program group – 50 points, interview – 25 points, and a recommendation letter from enterprises or organizations (if available) – 5 points.

## 3. Types and evaluation criteria

### 3.1 Criteria for evaluating the answers to the questions of the electronic examination card

The exam in the profile of the group of educational programs includes 3 blocks of questions, of which: the 1st question determines the level and consistency of theoretical knowledge; the 2nd question reveals the degree of formation of functional competencies; the 3rd question is aimed at determining systemic competencies. The maximum number of points is 50.

The electronic exam ticket consists of 3 questions:

| Blocks | The nature of the question | Number of points |
|---|---|---|
| 1st question | theoretical -determines the level and consistency of theoretical knowledge | 10 |
| 2nd question | practical - reveals the degree of formation of functional competencies (the ability to apply techniques, technologies and techniques in the subject area) | 20 |
| The 3rd question | it reveals a systematic understanding of the subject area under study, specialized knowledge in the field of research methodology (system competencies) | 20 |
| TOTAL | | 50 |

Criteria for evaluating the answers to the questions of the electronic examination card:

| Question | Evaluation criteria | Number of points |
|---|---|---|
| 1st question | demonstrates knowledge of the main processes of the subject area under study; the depth and completeness of the disclosure of the issue | 5 |
| | logically and consistently expresses his own opinion on the issue under discussion | 3 |
| | knows the conceptual and categorical apparatus, scientific terminology | 2 |

| | | |
|---|---|---|
| TOTAL | | 10 |
| 2nd question | applies methods, techniques, and technologies to solve problems in the subject area | 7 |
| | argues, compares, classifies phenomena, events, processes; draws conclusions and generalizations based on practical skills | 7 |
| | analyzes information from various sources | 6 |
| TOTAL | | 20 |
| The 3rd question | critically analyzes and evaluates theoretical and practical developments, scientific concepts and current trends in the development of science | 7 |
| | synthesizes methodological approaches in the interpretation of the main problems of subject knowledge | 7 |
| | identifies cause-and-effect relationships in the analysis of processes, phenomena, events | 6 |
| TOTAL | | 20 |
| In total | | 50 points |

### 3.2 Interview evaluation criteria

| № | Criteria | Descriptors | Points |
|---|---|---|---|
| 1. | **Motivation** | Argumentation of motives for studying for a doctoral degree in a selected OP and admission to a certain university. Vision of prospects for professional and personal growth upon completion of training. | 5 |
| 2 | **Research competence** | Possession of research skills and experience necessary for research activities in a specific subject area. | 10 |
| 3. | **Creativity** | Non-standard thinking, creative and alternative approaches to solving problems, situational tasks. | 5 |
| 4. | **Communicativeness** | The ability to briefly, representatively, logically, argumentatively state your point of view, make generalizations and conclusions. Language proficiency. | 5 |
| **Maximum number of points** | | | **25** |

## 4. Content of examination materials

### 4.1 The content of the sections on the blocks submitted for the entrance exam

Examination materials for the entrance exams to the doctoral program for groups of educational programs, including the subject of essays, examination questions on the profile are made in three languages: Kazakh, Russian and English.

The topics of the examination questions correspond to the selected sections from the curricula of the cycles provided for by the groups of educational programs "D100 - Automation and control":

| № | Name of disciplines |
|---|---|
| 1 | Electrical networks and systems |
| 2 | Electrical stations and substations |
| 3 | Relay protection and automation in power supply systems |

### 4.2 The content of the sections on the blocks submitted for the entrance exam

**Block 1**

Designs of power grid lines. Characteristics and parameters of electric power system elements. Operating modes of electric power systems. Electromechanical systems of electrical apparatus. Heating and cooling of electrical apparatus. Switching of electrical circuits. Electrodynamic forces in electrical apparatus. Electrical contacts. Low and high voltage switchgear devices. DC and AC electrical machines. High-voltage insulation. Overvoltages and protection against them.

**Block 2**

Indoor switchgear (ISG). Outdoor switchgear (OSG). Storage batteries. Materials used in electrical engineering. Transformer structure: magnetic circuit, windings, oil transformer tank, tank fittings. Transformer operating principle. Autotransformers: comparison of autotransformer and transformer. Electric arc. Low-voltage electrical apparatus.

**Block 3**

Purpose of relay protection and automation in power supply systems. Elements of relay protection and automation devices. Operating principle of automatic reclosing. Operating principle of automatic reserve connection. Protection and automation of station, substation and electricity consumers elements. Protection and automation of transmission line. Directional current protection. Distance protection. Differential current protection. Reliability of power plants and substations. Reliability of transmission lines.

### 4.3 Interview questions

1. Why did you decide to pursue a PhD in electrical power engineering?
2. What are your long-term career goals after receiving your PhD?
3. Why did you choose our university/research group to enroll in?
4. What specific scientific problems in modern electrical power engineering concern you the most and why?
5. How do you see the contribution of your future research to the development of electrical power engineering?
6. What can you, for your part, give to our educational institution if you are admitted?
7. Describe your research (or significant project). What were the key objectives, methods, results and your personal contribution?
8. What were the main challenges you encountered during your previous research/project and how did you overcome them?

9. What modeling, data analysis or experimental techniques did you use in your previous work (e.g. MATLAB/Simulink, PowerFactory/DIgSILENT, Python, EMTP-RV, laboratory benches)?

10. Do you have experience publishing scientific articles, presenting at conferences? If yes, please tell us about it. If no, how do you plan to develop these skills?

11. Describe your experience of working with scientific literature. How do you search for relevant publications and critically evaluate them?

12. Describe your preliminary vision of the topic of your doctoral research. What are the key goals and hypotheses?

13. How do you see the scientific novelty of your proposed research?

14. What, in your opinion, are the most critical challenges facing the modern electric power industry (at the level of the UPS, distribution networks, energy markets, etc.)?

15. What are your most important strengths for successful completion of your PhD? What areas would you like to improve during your studies?

## 5. Recommended literature

### 5.1 Basic literature


1. Лыкин Л.В. Электрические системы и сети. Учебник для СПО, 2019. -362с.

2. И. Г. Карапетян, Д. Л. Файбисович, И. М. Шапиро. Справочник по проектированию электрических сетей. Под ред. Файбисовича Д.Л. - 4-е издание. - М.: изд-во НЦ ЭНАС, 2012. - 376с.

3. Рожкова Л.Д., Карнеева Л.К., Чиркова Т.В. Электрооборудование электрических станций и подстанций. Издательский центр «Академия», 2013. -449с.

4. А. И. Гринь, Х. М. Мустафаев. Электрическая часть станций и подстанций. Учебное пособие, Ставрополь, 2002.

5. Алиев, И.И. Электрические машины / И.И. Алиев. - Вологда: Инфра-Инженерия, 2014. - 448 с.

6. Кацман, М.М. Электрические машины: Учебник / М.М. Кацман. - М.: Academia, 2017. - 320с.

7. Александров Г.Н. Электрические аппараты высокого напряжения. / Г.Н. Александров и др. Под редакцией Г.Н. Александрова. – Изд. 2-е. – СПб.: Изд-во СПбГТУ, 2000. – 503с.

8. Электрические и электронные аппараты./ П.А. Курбатов и др. Под редакцией П.А. Курбатова. - Москва.: Издательство Юрайт, 2016.- 440с.

9. Важов, В. Ф. Техника высоких напряжений: учебник / В.Ф. Важов, В.А. Лавринович. – Москва.: ИНФРА-М, 2018. - 262 с.

10. Киреева, Э. А. Релейная защита и автоматика электроэнергетических систем: учебник. / Э. А. Киреева, С. А. Цырук. - 5-е изд. – Москва.: Академия, 2016. - 287 с.

11. Андреев В.А. Релейная защита и автоматика систем электроснабжения. – 4-е изд., перераб и доп. – М.: Высшая школа, 2006. -639с.

12. Цыганков В.М. Надежность электрических систем и сетей. – Минск: БНТУ, 2001.-150с.

13. Возобновляемые источники электроэнергии: учебное пособие / Б.В. Лукутин. – Томск: Изд-во Томского политехнического университета, 2008. – 187 с.

14. Городов Р.В. Нетрадиционные и возобновляемые источники энергии: учебное пособие / Р.В. Городов, В.Е. Губин, А.С.Матвеев. - 1-е изд. - Томск: Изд-во Томского политехнического университета, 2009. - 294 с.

15. Харлов Н.Н. Электромагнитная совместимость в электроэнергетике: Учебное пособие. – Томск: Изд-во ТПУ, 2007. – 207 с.

16. Овсянников А. Г. Электромагнитная совместимость в электроэнергетике: учебник / Овсянников А. Г. Борисов Р.К. - Новосибирск : Изд-во НГТУ, 2017. - 196 с.

17. Волков Н.Г. Качества электроэнергии в системах электроснабжения. Томск: Томский политехнический университет, 2010. -152с.

18. Климова Г.Н. Электроэнергетические системы и сети. Энергосбережение: учебное пособие для вузов/ Г.Н. Климова. - 2-е изд. – Москва.: Издательство Юрайт, 2020. – 179 с.

### 5.2 Additional literature

1. Идельчик В.И. Электрические системы и сети: Учебник для вузов. - М.: Энергоатомиздат, 1989. - 592 с.: ил.

2. Стерман Л.С., Лавыгин В.М., Тишин С.Г. Тепловые и атомные электрические станции: Учебник для вузов. - М.: Издательство МЭИ,

3. Афонин, В.В. Электрические станции и подстанции: учебное пособие в 2 частях / В.В. Афонин, К.А. Набатов. – Тамбов.: Тамбовский государственный технический университет, 2017. – Ч. 2. – 98 с.

4. Копылов, И.П. Электрические машины в 2 т. том 1: Учебник для академического бакалавриата / И.П. Копылов. - Люберцы: Юрайт, 2016. - 267 с.

5. Копылов, И.П. Электрические машины в 2 т. том 2: Учебник для академического бакалавриата / И.П. Копылов. - Люберцы: Юрайт, 2016. - 407 с.

6. Москаленко, В.В. Электрические машины и приводы: Учебник / В.В. Москаленко. - М.: Академия, 2018. - 128 с.

7. Техника высоких напряжений./ И.М. Богатенков, Ю.Н. Бочаров, Н.И. Гумерова, Г.М. Иманов и др. Под ред. Г.С. Кучинского. - СПб.: Энергоатомиздат, 2003. – 608 с.

8. Лукутин Б.В. Возобновляемая энергетика в децентрализованном электроснабжении / Б.В. Лукутин, О.А. Суржикова., Е.Б. Шандрова. - М.: Энергоатомиздат, 2008. - 231 с.

9. Дьяков А.Ф., Максимов Б.К., Борисов Р.К., Кужекин И.П., Жуков А.В. Электромагнитная совместимость в эдектроэнергетике и электротехеике./ Под ред. А.Ф. Дьякова. -М.: Энергоатомиздат, 2003. -768 с.

10. Овсянников, А.Г. Электромагнитная совместимость в электроэнергетике: учебник / А.Г. Овсянников, Р.К. Борисов. – Новосибирск: Новосибирский государственный технический университет, 2011. – 194 с.

11. Мельников М.А. Релейная защита и автоматика элементов систем электроснабжения промышленных предприятий: учебное пособие / М.А. Мельников-Томский политехнический университет. - Томск: Изд-во ТПУ, 2008. - 218 с.

12. Бутенко В.А. Техника высоких напряжений: учебное пособие / В.А. Бутенко, В.Ф. Важов, Ю.И. Кузнецов, Г.Е. Куртенков, В.А. Лавринович, А.В. Мытников, М.Т. Пичугина, Е.В. Старцева. - Томск: Изд-во ТПУ, 2008. - 119 с.