NON-PROFIT JOINT-STOCK COMPANY
«KARAGANDA TECHNICAL UNIVERSITY NAMED AFTER ABYLKAS SAGINOV»

Academic Council
protocol № 11
«30» 04 2025 year

PROGRAM
THE ENTRANCE EXAM

for admission to the doctoral program in the educational program
8D07103 «Electrical Power Engineering»

Department of «Automation of production processes»
Compiled by: PhD Smagulova K.K.

The program of the entrance exam for the educational program
8D07103 – «Electrical Power Engineering was developed by PhD Smagulova K.K.

Reviewed at the meeting of the Department of APP
Protocol №16 April 08, 2025.
Head of the Department of APP_____ V.V. Yugay

1. List of topics for Module 1 «Modern problems of electric power engineering».

Disciplines:

1. «Scientific and technical problems of electric power engineering of energy systems».

1. Basic characteristics of energy.
2. Improving the technology of using energy resources.
3. New solar technologies. Wind energy. Hydraulic and thermal energy of the world ocean.
4. Reliability of energy supply to consumers.
5. Decentralization of energy supply. New materials in energy.
6. Energy saving in power engineering, increasing the efficiency of energy conversion during the production and transmission of electric power.
7. Overcoming global contradictions between Humanity and the Environment.
8. Laws of the Republic of Kazakhstan “On Electric Power Industry”, “On Energy Saving”, “On Air Protection”, “On Support of the Use of Renewable Energy Sources”.
9. Issues of application of low-energy technological processes and consumers.
10. Structure of the electric power industry.
11. Improving the technical and economic performance of the main equipment.
12. Modern switching equipment.
13. Issues of electricity transmission.
14. Problems of ensuring the main indicators of electric power quality.
15. Problems of increasing the reliability and electrical strength of insulation of electrical equipment and power lines. Application of new insulation structures.

List of literature

1.Ревелль П., Ревелль Ч. Среда нашего обитания. Энергетические проблемы человечества. в 4- х томах, кн.3. Перевод . английского, М., с «Мир», 1995, с.291, ил. ISBN 5.03-0028696-X

3. Дукенбаев К. Энергетика Казахстана. Движение к рынку. Алматы: Fылым, 1998. - 584 с. ISBN 9965-01-099-4. аспект, Апматы, 2014. -312 с.

4. Дукенбаев К. Энергетика Казахстана. Условия и механизмы её устойчивого развития. - Апматы, 2014.

7. Возобновляемая энергия. Ежеквартальный информационный бюллетень. Издание Российского центра солнечной энергии. ОПЭТ СНГ. - Москва: "Интерсопарцентр".

8. Герасименко А.А., Федин В.Т. Передача и распределение электрической энергии. Ростов на Дону, ИЗД. «Феникс» 2014 г.

9. Лыкин Л.В. Электрические сети и системы. М.: Логос. 2014.

10. Железко Ю.С., Артемьев А.В., Савченко О.В. Расчет, анализ и нормирование потерь электроэнергии в электрических сетях. М.: «Изд. НЦ ЭНАС», 2014.

11. Болотов А.В., Болотов С.А. К программе развития ветроэнергетики Казахстана. Энергетика и топливные ресурсы Казахстана, №1, 2009,Алматы, стр. 33 - 37.

12. Болотов А.В. Сидельковский В.С., Болотов с.А. Тенденции развития ветроэнергетики в мире. Вестник Национальной инженерной академии Республики Казахстан, *N!!* 4 (18) ISSN 1606-146X, стр.78- 84

13. Возобновляемая энергия. Ежеквартальный информационный бюллетень. Издание Российского центра солнечной энергии. ОПЭТ СНГ. Москва. "Интерсоларцентр"

14. Герасименко А.Л., Федин ВТ. Передача и распределение электрической энергии. Ростов на Дону, изд. «Феникс» 2014 г.

15. Евдокунин Г.А. Электрические системы и сети: Учебное пособие для электроэнергетических спец. вузов. - СПб.: Издательство Сизова м.п., 2014.

16. Управление качеством электроэнергии/ под Ю.В. Шарова. - М.: МЭИ, 2016

2. «Energy-saving technologies in electric power engineering and automation».

1.General issues of energy saving economics.
2.Energy management.
3.Energy audit.
4.Energy service contracts as a mechanism for financing measures to improve energy efficiency.
5.Energy-saving technologies. Instrumentation and control systems for power engineering.
6.Principles of construction and examples of construction of systems for recording and monitoring parameters of electricity consumption, heat consumption, gas and water consumption.Indicators of electric power quality and their assessment when supplying controlled asynchronous electric drives.
7.Modern energy-saving and resource-saving technologies.
8.Automation of technological processes of the gas-mechanical plant based on a frequency-controlled electric drive as a means of resource and energy saving.Results of modernization and automation of the main types of technological machines by replacing and installing frequency-controlled electric drives of production mechanisms to improve energy efficiency and energy saving
9.Technologies and automation tools for energy saving in the mining and metallurgical complex.Energy efficiency and energy saving indicators of GMP.
10. Technologies and automation tools for energy saving in mechanical engineering.Energy efficiency and energy saving indicators.
11. Technologies and automation tools for energy saving in electric and thermal power engineering.Energy efficiency and energy saving indicators.
12. Technologies and automation tools for energy saving in transport.Ways to reduce energy consumption when using industrial transport with a controlled electric drive. Energy efficiency and energy saving indicators.
13. Technologies and automation tools for energy saving in construction.Energy efficiency and energy saving indicators.
14. "Intelligent (smart) home" systems as a means of resource and energy saving.Automation of life support processes for domestic, administrative, and cultural and sports buildings and structures based on energy efficiency, energy conservation and resource conservation.
15. Integrated control systems for energy and technical complexes. Operational dispatch control systems as a means of increasing efficiency and energy saving. Integrated energy-saving automated process control systems (APCS) and automated production control systems (APCS). SCADA systems.

List of literature

1 Колосов О. С [и др. Технические средства автоматизации и управления: учебник для вузов / под общей редакцией О. С. Колосова. – М: Издательство Юрайт, 2021. – 291 с.

2 Старостин, А. А. Технические средства автоматизации и управления : учеб. пособие / А. А. Старостин, А. В. Лаптева. — Екатеринбург : Изд-во Урал. ун-та, 2015 — 168 с.

3 Сазонникова, Н. А. Управление технологическими процессами: учеб. пособие / – Самара: Издательство Самарского университета, 2017. – 192 с.

4 Бородин И. Ф., Андреев С. А., Автоматизация технологических процессов и системы автоматического управления. 2-е издание, исправленное и дополненное –,М: : Издательство Юрайт, 2018. – 386 с.

5 Федоров Ю.Н Справочник инженера по АСУТП, Проектирование и разработка, Том 1, М.: Инфра-Инженерия, 2016. – 448 с.

6 Манвейкин В.Т., Фролов СВ., Шехтман М.Б. Применение SCADA-систем для автоматизации технологических процессов: Учебное пособие. -М.-Тамбов: Машиностроение, -2014. – 176 с.

7 Цирлин, А.М. Оптимальное управление технологическими процессами / А.М. Цирлин. - Л.: Энергоатомиздат, 2015. - 400 с.
8 Меркер, Э. Э. Энергосбережение в промышленности и эксергетический анализ технологических процессов. Учебное пособие / Э.Э. Меркер. - М.: ТНТ, 2014. - 316 с.
9 Оценка экономической эффективности энергосбережения. Теория и практика. - М.: Теплоэнергетик, 2015. - 400 с.
10 Свидерская, О. В. Основы энергосбережения. - М.: ТетраСистемс, 2016. - 176 с.
11 Смагулова К.К., Брейдо И.В., Сагитов П.И. Энергосберегающие технологии в автоматизации и электроэнергетике: учеб. пособие. – Караганда: Изд-во КарГТУ, 2017. – 102 с. ISBN 978-601-315-254-7
12 Авдеев Л.А. Энергосберегающие технологии в угольных шахтах: монография / Карагандинский государственный технический университет. – Караганда: Изд-во КарГТУ, 2018. – 159 с. ISBN 978-601-315-496-1
13 Арутюнян, А. А. Основы энергосбережения: моногр. - М.: Энергосервис, 2014. - 600 с.

3. «Non-traditional and renewable energy sources».

1 Energy of Kazakhstan. Ways of its development.
2 Solar energy. Solar installations. Solar vehicles.
3 Solar energy converters. Solar light concentrators. Solar heating.
4 History of wind power development. Systems and types of wind turbines.
5 Wind energy. Types of winds used. Wind energy storage.
6 Thermal energy of the Earth. Energy of internal waters. Energy of natural disasters.
7 Hot systems of volcanic origin. High heat flow system
8. Energy of the world ocean. Energy of the tides.
9 Energy of ocean currents. Thermal energy of the ocean.
10 Energy of rivers.
11 Internal energy of water molecules.
12 Hydrogen energy. Modern and promising methods of hydrogen production.
13 Use of methane for energy purposes.
14 Environmental issues of using alternative and renewable energy sources

List of literature

1. Удалов С.Н. Возобновляемые источники энергии / С.Н. Удалов // Новосибирск: НГТУ, 2014.-459с.:ISBN 978-5-7782-2467-4 (электронный ресурс) http://znanium.com/bookread2.php?book=556622
2. Сибикин Ю. Д. Технология энергосбережения [Электронный ресурс]: учебник / Ю. Д. Сибикин. - Москва: Издательство 'ФОРУМ', 2013. - 352 с. - (Профессиональное образование). - ISBN 978-5-91134-596-9. – Режим доступа: http://znanium.com/go.php?id=400962
3. Твайделл Дж. Возобновляемые источники энергии [Текст] / Дж. Твайделл, А. Уэйр ; пер. с англ. В. А. Коробкова. - Москва: Энергоатомиздат, 2020. - 408 с.: ил. - Библиография: с. 386-387. - Заглавие и авт. оригинала: Renewable energy resources / J. W. Twidell, A. D. Weir. - В пер. - ISBN 5-283-02469-5 (рус.), 1990. - 392 с. - ISBN 0-419-12000-9 (англ.).
4. Протасевич А. М. Энергосбережение в системах теплогазоснабжения, вентиляции и кондиционирования воздуха [Электронный ресурс] : учебное пособие / А. М. Протасевич. - Москва: ООО 'Научно-издательский центр ИНФРА-М', 2013. - 286 с. - ISBN 978-5-16-005515-2. - Режим доступа: http://znanium.com/go.php?id=405334.
5. Сибикин Ю. Д. Нетрадиционные и возобновляемые источники энергии [Текст]: учебное пособие / Ю. Д. Сибикин, М. Ю. Сибикин. - Москва: КНОРУС, 2012. - 228 с. - ISBN 978-5-

406-00278-0. (21 экз.). Программа дисциплины "Нетрадиционные и возобновляемые источники энергии"; 13.03.01 Теплоэнергетика и теплотехника; старший преподаватель, б/с Хазиев М.Л.
6. Ляшков В. И., Кузьмин С. Н.. Нетрадиционные и возобновляемые источники энергии: учебное пособие [Электронный ресурс]. – Тамбов: Изд-во ФГБОУ ВПО «ТГТУ», 2012. – 95с., (http://biblioclub.ru/index.php?page=book&id=277820).
7. Федянин В. Я. Инновационные технологии для повышения эффективности алтайской энергетики. – Барнаул: [б. и.], 2014. Ши20.9(571.15) Ф 356, НТБ АлтГТУ им. И. И. Ползунова.

2. List of topics for Module 2 «Scientific and technical problems of energy».

Disciplines:

1. «Theory of Experiment».

1. Classification, types and objectives of the experiment. Single-factor and multi-factor experiment.
2. Basic principles and concepts of probability theory and mathematical statistics. Random events, probability of an event.
3. Theory of random errors. Processing of experimental data of measurement results. Fundamentals of the theory of random errors.
4. Statistical processing of experimental research results. Statistical, null, alternative hypotheses.
5. Similarity and modeling in scientific research. Similarity theorems. Types of models: conceptual, cybernetic, electronic, physical, analog, mathematical.
6. Application of artificial intelligence algorithms for visualization and analysis of experimental research results.
7. Calculation of mathematical expectation, dispersion and standard deviation for continuous and discrete random variables. Artificial intelligence methods for automated calculation of statistical characteristics of random variables.

List of literature

1Ефимова О.В., Моисеева М.В., Ю.А. Шафрин Практикум по компьютерной технологии. Примеры и упражнения. - Москва: ABF, 2017

2Горячев А., Шафрин Ю. Практикум по информационным технологиям. М.: Лаборатория базовых знаний, 2011

3Син В.М. Методические указания к лабораторным работам по курсу «Применение ЭВМ в электрических расчетах и эксперименте». Караганда: КарГТУ, 2014.-52с.

4Документация к пакетам прикладных программ.

5Борисов Ю.М. , Липатов Д.Н., Зорин Ю.Н. Электротехника:Учебное пособие для вузов.-М.,2015.-552с.

6 Болотов, А.В. Нетрадиционные и возобновляемые источники электроэнергии: учебное пособие для студентов / А. В. Болотов, 2011. - 78 с.

2. "Electric drive control systems".

1 Introduction
2 Logical control of electric drives.Typical nodes of control and protection circuits. Typical relay-contactor.DC SUEP. Typical relay-contactor Automatic control circuits for AD and SD.
3 Mathematical description and principles of construction of control systems. Mathematical model of a DC electric motor. Controlled rectifier. Implementation of regulators.
Mathematical models of an AC electric machine.
Principles of electric drive coordinate control. Standard settings of the simplest contours. Typical modes of mechanism control. Stabilization, tracking, positioning. Synchronization of speeds and positions. Electric drive load control.
4 Closed-loop control systems for speed and torque of a DC electric drive. Electric drive with feedback by EMF. Electric drive with delayed feedback by current with cutoff. Electric drive with feedback by speed and current with cutoffs.
Electric drive with subordinate control of parameters.
5 Speed control systems for asynchronous electric drives.

Frequency control $U/f = const$.
Frequency control with constant magnetic flux.
Vector control of AC electric drive.
6 Control systems for electric drives of technological complexes. Typical functions of process line control systems.
Pump electric drive control system with frequency converter. Machine tool control systems for metalworking machines.
Control system for flying shears. Control systems for electric drives of reversible rolling mills. Composition and properties of control systems. mining equipment. Unified control systems for electric drives of single-bucket excavators.
Control systems for interconnected electric drives of continuous-flow production.
7. Electric drive control systems in tracking modes and in positioning modes. Adaptive electric drive control systems.
8. Software implementation of electric drive control tools.

List of literature

1. Системы управления электротехническими комплексами: учебное пособие для студентов и магистрантов специальностей 6М070200-"Автоматизация и управление", 6М071800 - "Электроэнергетика", "Системы управления электротехническими комплексами", "Системы управления электроприводами" / И. В. Брейдо, Л. М. Лапина; Министерство образования и науки Республики Казахстан, Карагандинский государственный технический университет, Кафедра "Автоматизация производственных процессов". - Караганда: КарГТУ, 2018. - 94 с.: ил. - (Рейтинг). - ISBN 978-601-315-472-5
2. Системы управления электротехническими комплексами: учебное пособие для студентов, магистрантов специальности 6М071800 "Электроэнергетика", 6М070200 "Автоматизация и управление" / И. В. Брейдо, Л. М. Лапина. - Алматы: Cyber Smith, 2018. - 122 с.: ил. - (Рейтинг). ISBN 978-601-310-519
3. Системы управления и контроля автоматизированных технологических комплексов (часть 2): учеб. пособие / Б.Н. Фешин, К.М. Тохметова; Карагандинский государственный технический университет. – Караганда: Изд-во КарГТУ, 2018. 100 с. ISBN 978-601-315-460-2
4. Многосвязные супервизорные системы управления угледобывающими машинами: монография / Б. Н. Фешин; М-во образования и науки РК, Карагандинский государственный технический университет, Кафедра "Автоматизация производственных процессов". - Караганда: КарГТУ, 2018. - 165 с. - (Рейтинг). ISBN 978-601-315-470-1
5. Системы управления и контроля автоматизированных технологических комплексов (часть 1): учеб. пособие / Б.Н. Фешин, К.М. Тохметова; Карагандинский государственный технический университет. – Караганда: Изд-во КарГТУ, 2017. – 107 с. ISBN 978-601-315-347-6
6. Системы оперативно-диспетчерского управления автоматизированных технологических комплексов: учебное пособие для магистрантов / Б. Н. Фешин, Г. И. Паршина; Карагандинский государственный технический университет, Кафедра "Автоматизация производственных процессов". - Караганда: КарГТУ, 2017. - 96 с. - (Рейтинг). ISBN 978-601-315-271-4
7. Системы автоматики и телемеханики: учебное пособие для студентов и магистрантов / Г. А. Эм, В. В. Каверин; Карагандинский государственный технический университе. - Караганда: КарГТУ, 2015. - 145 с. - (Рейтинг). ISBN 978-601-315-044-4
8. Создание и эксплуатация автоматизированных систем: учебное пособие для магистрантов и докторантов спец. "Автоматизация и управление" и "Электроэнергетика" / Л.

А. Авдеев; М-во образования и науки РК, Карагандинский государственный технический университет. - Караганда: КарГТУ, 2014. - 128 с. - (Рейтинг). ISBN 978-601-296-774-6
9. Автоматизированные системы контроля и управления безопасностью в угольных шахтах: монография / Л. А. Авдеев; Карагандинский государственный технический университет. - Караганда: КарГТУ, 2013. - 193 с. : ил. - (Рейтинг). - ISBN 978-601-296-469-1

3. «Modeling of electric drives».

Topic 1, 2. Elements of adjustable electric drive, features of simulation modeling.
Topic 3.4 MATLAB. Simulink and Simpower Systems libraries.
Topic 5. Simulation modeling Diodes. Thyristor. Triac Series connection of valves. Parallel connection of valves.
Topic 6.7. Simulation modeling Single-phase thyristor rectifiers. Half-controlled thyristor rectifiers. Fully controlled thyristor single-phase converter. Three-phase controlled rectifiers. AC voltage switch.
Topic 8.9. MATLAB Simulink libraries, modeling methods.
Topic 10. Structural diagram of an adjustable electric drive.
Topic 11. Modeling of power supply systems of a controlled electric drive.
Topic 12. Modeling the mechanical part of an adjustable electric drive.
Topic 13. Modeling of controlled rectifiers.
Topic 14. Modeling of pulse converters.
Topic 15. Modeling of a three-phase rectifier and a three-phase AC switch. Calculation and selection of parameters of power section elements.
Topic 16. Modeling of an autonomous AC inverter (AAVI) and a grid-followed inverter. AC inverter with a DC link.
Topic 17. Modeling of DC electric motors with series, independent and mixed excitation.
Topic 18. Modeling of an asynchronous electric motor with a squirrel-cage rotor and a phase rotor.
Topic 19. Modeling of a synchronous electric motor.
Topic 20. Modeling of electric drive control system.

List of literature

1. Ордынцев В.М. Математическое описание объектов автоматизации. – М.: Машиностроение, 2019. – 360с.
2. Башарин А.В., Новиков В.А., Соколовский Г.Г. Управление электроприводами: Учебное пособие для вузов. – Л.: Энергоатомиздат. Ленингр.отд-ние, 2017.- 392с.
3. Дейч А.М. Методы идентификации динамических объектов. – М.: Энергия, 2019. – 240с.
4. Ротач В.Я. Расчет динамики промышленных автоматических систем регулирования. М.: Энергия, 2020. – 440с.
5. Беленький А.М., Бердышев В.Ф., Блинов О.М., Каганов В.Ю. Автоматическое управление металлургическими процессами: Учебник для вузов. – с
6. Дьяконов В.П. MATLAB 6/6.1/6.5. / Под ред В.Б. Яковлева. М.: Высшая школа, 2016.– 263с.
7. Карлащук В.И. Электронная лаборатория на IBM PC. Лабораторный практикум на базе Electronics Workbench и Matlab. М.: СОЛОН-Пресс, 2014

3. List of topics for Module 3 «Programming Industrial Controllers».

Disciplines:

1. «Programming industrial controllers».

Application software for PLC programming. Typical structure of automated control system based on PLC.
Analyze the methods of programming industrial controllers according to the IEC 61131 standard. Identify the main advantages and disadvantages of PLC design languages.
Standard operators of IEC languages. Standard components of IEC languages. Resources, equipment, task synchronization.
To analyze the features, advantages and disadvantages of software for various lines of controllers.
Creation of process control systems based on standard blocks
To systematize automation systems and tools using computer-aided design technologies.
Study of PLC programming languages based on the STEP7 and TIA-portal tool systems.
To identify the main features of designing systems and automation tools using application environments for PLC programming.
Creation of control systems. Combination logic, creation of a control program according to a given algorithm.
To analyze the main methods of construction and features of operation of SCADA systems of production processes.
Basics of working in WinCC-flexable – environment for developing operator panels. Establishing communication with the controller.
To identify the main trends in the development of modern automation tools.

List of literature

1. Петров И. В. Программируемые контроллеры. Стандартные языки и приемы прикладного проектирования; ред. В. П. Дьяконова / И. В. Петров - М.: СОЛОН-Пресс, 2016. – 255 с.
2. Гофман, П. М. Инструменты программирования промышленных контроллеров. SFC : учеб. пособие / П. М. Гофман, П. А. Кузнецов, В. В. Лосев ;. – Красноярск: СибГУ им. М. Ф. Решетнева 2019. – 84 с.
3. Сергеев, А. И. Программирование контроллеров систем автоматизации: учебное пособие / А. И. Сергеев, А. М. Черноусова, А. С. Русяев. – Оренбург: ОГУ, 2016. – 125 с.
4. Дятлова Е.П. Проектирование автоматизированных систем управления технологическими процессами: учебно-методическое пособие/ ВШТЭ СПбГУПТД. СПб., 2019. – 68 с
5. Руководство программиста CODESYS. АГСФ.421445.005 РП – Екатеринбург: КБ АГАВА– 2020. – 155 с.
6. Паршина Г. И. Программное обеспечение промышленных контроллеров: учебное пособие. Ч. 1. – Караганда: КарГТУ, 2018. - 110 с.
7. Паршина Г. И. Программное обеспечение промышленных контроллеров: учебное пособие . Ч. 2. – Караганда : КарГТУ, 2019. - 105 с.
8. Руководство пользователя по программированию ПЛК в CoDeSys: ПК Пролог (Русская редакция), 2017. – 453 с. URL: http://www.kipshop.ru/ CoDeSys /
9. Визуализация CoDeSys. Дополнение к руководству пользователя по программированию ПЛК в CoDeSys 2.3 – ПК Пролог (Русская редакция), 2018. URL: http://www.kipshop.ru/ CoDeSys / steps / codesys_visu_v23_ru.pdf
10. SIMATIC HMI. WinCC. Начало работы. Руководство. Электронное издание.
11. Русская документация по SIMATIC, ООО «Сименс» Департамент техники автоматизации и приводов: Москва. Электронное издание.
12. Программируемый контроллер S7-300. SIMATIC. Данные модулей. Справочное руководство. SIEMENS. Электронное издание A5E00105505-03.

13. Программируемый контроллер S7-300. Данные CPU, CPU 31xC и CPU31x. Справочное руководство. SIEMENS. Электронное издание A5E00105475-02.

3. List of topics for Module 3 «Design of electric drive systems».

Disciplines:

1. «Modern theories, methods and means of creating automation and control systems».

1 Modern control theory and systems theory. Mathematical research methods.
2. New objects and tasks of management in technology, economics, social and biological systems. Universal nature of the basic principles of management and the interdisciplinary nature of management science.
3. Methods of analysis and synthesis of control systems under conditions of incomplete certainty.
4. Methods for describing control objects in state space coordinates.
5. Observability. Identifiability. Controllability. Adaptability.
6. Stability of processes in state space. Methods of the theory of absolute stability.
7. Robust and invariant systems. Classification of robust control systems. Uncertain control systems. Robust stability.
8. Methods and algorithms for assessing dynamic processes.
9. Methods and algorithms for identification of dynamic systems.
10. Criteria for control optimization. Some general methods of optimal control theory. Optimal control algorithms. Optimization of dynamic systems.
11. Algorithms of adaptive automatic control systems. Method of recurrent target inequalities in adaptive control.
Extreme control systems. Methods and algorithms of estimation in correlation-extreme systems.
13. Methods of sensitivity theory.
14. Search methods of automation. Automation of design of automatic control systems.
15. Software for simulating dynamic systems.

List of literature

1. Фешин Б.Н., Паршина Г.И. и др. Компьютерное моделирование и идентификация электротехнических комплексов: Учебное пособие. Ч.1. Караганда: КарГТУ, 2015. 98с.
2. Фешин Б.Н., Паршина Г.И. и др. Компьютерное моделирование и идентификация электротехнических комплексов: Учебное пособие. Ч.2. Караганда: КарГТУ, 2015. 88с.
3. Фешин Б.Н., Паршина Г.И. и др. Компьютерное моделирование и идентификация электротехнических комплексов: Учебное пособие. Ч. 3. Караганда: КарГТУ, 2016. 64с.
4. Фешин Б.Н., Паршина Г.И. Программные средства и технологии моделирования. (часть 1). Учебное пособие /Б.Н. Фешин, Г.И. Паршина; Карагандинский государственный технический университет. – Караганда: Изд-во КарГТУ, 2017. – 82с.
5. Фешин Б.Н., Паршина Г.И. Программные средства и технологии моделирования. (часть 2). Учебное пособие /Б.Н. Фешин, Г.И. Паршина; Карагандинский государственный технический университет. – Караганда: Изд-во КарГТУ, 2017. – 121с.

2. «Automation of electrical complexes of mining and metallurgical production».

1. Introduction. Basic concepts of automation of technical systems. Classification of electrical complexes (EC) of mining and metallurgical enterprises (MME) as automation objects.
2. Basic principles of automation of the EK GMP. Classification of control systems of the EK GMP by automation levels.
3. Automation of power supply systems of the EK GMP. Principles, methods and means of managing the quality of electricity in power supply systems of the EK GMP, including surface and underground facilities of the USh.

4. Automation of mining and quarrying enterprises' power supply systems. Properties and characteristics of power supply systems (PSS) of metallurgical enterprises (ME) as control objects. Principles, methods and means of automation of PES of ME.
5. Automation of the EC of metallurgical enterprises. Properties and characteristics of the power supply systems (PS) of metallurgical enterprises (ME) as control objects. Principles, methods and means of automation of the PE of ME.
6. Automation of coal mine hoisting equipment.
7. Automation of the electronic control systems of coal mine production areas.
8. Automation of mining equipment for coal mine heading sections.
9. Automation of stationary conveyor systems of coal mines.
10. Automation of open-pit coal mine excavator control systems.
11. Automation of hot rolling mill electronics.
12. Automation of cold rolling mill electronics.
13. Automation of continuous annealing and electrolytic tinning units.
14. Automation of electric heating furnaces.
15. Integrated control systems for electrical complexes, technological processes and production of mining and metallurgical enterprises.

List of literature

1. Автоматизация типовых технологических процессов и установок: Учебник для вузов / А.М. Корытин, Н.К. Петров, С.Н. Радимов, Н.К.Шапарев. – М.: Энергоатом-издат, 2020. – 432.

2. Ордынцев В.М. Математическое описание объектов автоматизации. – М.: Машиностроение, 2019. – 360с.

3 Соколовский Г.Г. Управление электроприводами: Учебное пособие для вузов. – Л.: Энергоатомиздат. Ленингр.отд-ние, 2018.- 392с.

4. Беленький А.М., Бердышев В.Ф., Блинов О.М., Каганов В.Ю. Автоматическое управление металлургическими процессами: Учебник для вузов. – Л.: Энергоатомиздат. Ленингр.отд-ние, 2020.- 392с.

5. Брейдо И.В., Каверин В.В., Усова Е.Д., Эм Г.А.. Лабораторно-практический комплекс по электроприводу и преобразовательной технике. Изд-во КарГТУ, 2011. – 85 с.

6. Проектирование систем автоматизации технологических процессов: Справочное пособие / [А.С. Клюев, Б.В. Глазов, А.Х. Дубровский, А.А. Клюев]; Под ред. А.С. Клюева. – М.: Энергоатомиздат, 2018. – 464 с.: ил.

7. Техника чтения схем автоматического управления и технологического контроля / [А.С. Клюев, Б.В. Глазов, М.Б. Миндин, С.А. Клюев]; Под ред. А.С. Клюева. – М.: Энергоатомиздат, 2015. – 432 с.: ил.

8. Фешин Б.Н. Автоматизация промышленных установок и технологических комплексов: Учеб. пособие. – Караганда, КарГТУ, 2010. – 100 с.

9. Красовский А.А. Справочник по теории автоматического управления. – М.: Наука, 2021. – 712 с.

The subject of the Essay

$$$001
DC and AC electric motors.

$$$002
Electroconverting devices in the electric power industry.

$$$003
Sensors in the electric power industry and electromechanics.

$$$004
Electrotechnological systems and complexes.

$$$005
Renewable and non-traditional sources of electricity.

$$$006
High-voltage electric drives.

$$$007
Features and structures of control and protection systems for high-voltage power transmission lines.

$$$008
Adaptive control systems for electric drives.

$$$009
Mathematical modeling of electric drives.

$$$010
Typical structures of controlled DC and AC electric drives.

1. The program of the entrance exam for Module 1 «Modern problems of electric power engineering» (list of exam questions).

1. The concept of "Electric power industry". Objects of analysis and research in the specialty "Electric Power Engineering". Electrical engineering complexes. Electrical engineering systems.
2. Classification of electrotechnical complexes and electrotechnical systems.
3. Traditional technologies for generating electric energy.
4. Methods and technologies of using electric energy.
5. Methods and technologies of electric power transmission.
6. Theoretical foundations of electrical engineering. Methods for calculating DC circuits.
7. Theoretical foundations of electrical engineering. Methods for calculating AC circuits.
8. Theoretical foundations of electrical engineering. Electromagnetic induction. Principles of operation and patterns of conversion of mechanical energy into electrical energy. Electric generators.
9. Theoretical foundations of electrical engineering. Principles of operation and patterns of conversion of electrical energy into mechanical energy. Electric motors.
10. Theoretical foundations of electrical engineering. Three-phase circuits and systems. The principle of operation of asynchronous electric motors.
11. Theoretical foundations of electrical engineering. Transients in electrical circuits.
12. The balance of active and reactive power in the electrical system.
13. Characteristics of the quality of electricity. Network influence on the propagation of constructive interference.
14. The influence of electricity quality on the operation of electric receivers.
15. Means of measuring the quality of electricity.
16. Quality control of electric power. Automated metering systems and power consumption parameters.
17. Methods and technical means of ensuring the quality of electricity.
18. Types of regulated asynchronous electric drives and their energy indicators.
19. Ways to reduce power consumption when using electric drives.
20. Automation of technological processes based on a frequency-controlled electric drive as a means of resource conservation and energy conservation. The main ways to increase the energy efficiency of electric drives.
21. Energy efficiency of asynchronous electric drives of kinematically connected electric drives.
22. Energy efficiency of asynchronous electric drives of centrifugal pumps.
23. Energy efficiency of asynchronous electric drives of fans and turbochargers.
24. Energy efficiency of asynchronous electric drives of reciprocating machines.
25. Energy efficiency of asynchronous electric drives of conveyors and transporters.
26. Energy efficiency of control of arc steelmaking furnaces.
27. Features of semiconductor frequency converters.
28. Efficiency of transformation systems in housing and communal services facilities.
29. Classification of renewable sources of electric energy.
30. Principles of using solar energy to generate electric energy.
31. Principles of using wind energy to generate electrical energy.
32. Principles of using the tides of the sea to generate electric energy.
33. Principles of using biological waste to generate electrical energy.
34. Principles of using geothermal energy to generate electrical energy.
35. Principles of using nuclear fission energy to generate electrical energy.
36. Principles of using thermonuclear fusion to generate electrical energy.
37. Principles of generating electric energy based on hydrogen energy.
38. Principles of construction of energy storage devices when using non-traditional sources of electric energy.

39. Reconstruction and modernization of the technical equipment of electric power plants. Problems and prospects of development of non-traditional and renewable energy sources.

40. Energy and technological opportunities and prospects for the use of non-traditional and renewable energy sources for energy supply to combined and autonomous consumers.

41. Problems of electricity transmission in backbone networks. Problems of electricity transportation in distribution networks. The problem of ensuring the capacity of electrical networks of different classes of rated voltage. New tasks and control objects in electrical networks.

42. Control of reactive power flows in electrical networks. The problem of the quality of electricity in its transmission and distribution. Transfer of networks to power transmission lines and new generation equipment. The main trends in the development of electric networks.

43. Principles of construction and structure of automated technological complexes (ATC) with multi-motor electric drive systems. Typical ATC structures.

44. Principles of construction and structure of automated technological complexes (ATC) with multi-motor electric drive systems. Technical means of ATC complexes.

45. Principles of construction and structure of automated technological complexes (ATC) with multi-motor electric drive systems.

46. Power networks of ATC (automated technological complexes).

47. Principles of construction and structure of automated technological complexes (ATC) with multi-motor electric drive systems.

48. ATK information networks.

49. Operating modes of the technological equipment of the ATC.

50. Control algorithms for electric drives, mechanisms, units and complexes. Mathematical models and structures of control systems.

2. The program of the entrance exam for Module 2 «Scientific and technical problems of energy» (list of exam questions).

1. Mathematical modeling as a means of understanding and analyzing technical systems. Purpose, types and functions of models.
2. Mathematical models, mathematical modeling, basic concepts and definitions.
3. Tasks of studying electrical systems using methods of mathematical and simulation modeling.
4. Identification. Basic concepts and definitions. Mathematical foundations of modeling dynamic systems.
5. Features of technological processes as objects of modeling and identification.
6. Concepts of methods of identification of technical systems in static modes.
7. Concepts of methods for identifying technical systems in dynamic modes.
8. Methods for obtaining and forms of presentation of mathematical models of dynamic systems (using examples of a DC motor with an independent excitation winding).
9. Algorithms and software for solving problems of modeling dynamic systems on a PC.
10. Mathematical modeling of dynamic systems in the WINDOWS environment in the TURBO-BASIC algorithmic language.
11. Modeling of dynamic systems by the method of reducing the order of the derivative in the environment of problem-oriented application packages.
12. MATLAB-SIMULINK software system. Extensions of MATLAB software for identification of dynamic objects and systems.
13. Extensions of MATLAB PPP for studying electrical engineering objects and systems. Simulink library – prototypes of electrical engineering blocks.
14. Features of modeling power electronics circuits. Software systems for circuit modeling Proteus and Multisim.
15. Symbolic modeling software system MathCAD.
16. Adaptive systems for automatic control of technical objects with modeling and identification loops.
17. Adaptive automatic control systems with identification of models based on monitoring results using SCADA systems.
18. Calculation schemes of automated electric drive. Basic equation of motion of electric drive.
19. Calculation schemes of the mechanical part of the electric drive. Typical static loads of the electric drive.
20. Dynamic processes in the mechanical part of the electric drive.
21. Classification of automatic control system of electric drive and automated control system of electric drive.
22. Relay control systems for electric drives.
23. Principles of construction of automatic control systems for adjustable electric drives.
24. Main design parameters of DC motors in automated electric drive systems.
25. Mathematical models of DC motors.
26. Typical circuit diagrams of an automated DC electric drive.
27. Irreversible electric drive TPD.
28. Mathematical modeling of elements and systems of automated AC electric drives.
29. Principles of construction of automated AC electric drive systems.
30. Parametric optimization of dynamic systems.
31. A technique for planning full factorial experiments and steep ascent in the direction of the antigradient of the objective function.
32. Design stages and composition of projects for electric drives and automation systems.
33. Technical means of automated electric drive systems.
34. Calculation of operating modes and selection of automated electric drives.

35. Software for automated electric drives.
36. Technical means of automation systems.
37. Software for automation systems.
38. Technologies for increasing the reliability of automated electric drive and automation systems.
39. Technologies for designing automated electric drives and automation systems.
40. Technologies for carrying out installation, adjustment and operational work with automated electric drives and automation systems for technological processes.
41. The concept of integrated technologies for creating electric power systems. Complete DC electric drives.
42. The concept of integrated technologies for creating electric power systems. Complete AC electric drives.
43. Electromechanical and electrical complexes as components of integrated automation systems.
44. Characteristics of the current state of energy saving in the electric power industry and the level of efficiency of energy resources. The main reasons for the low energy efficiency of facilities.
45. Review of regulatory legal acts governing relations on energy saving and increasing energy efficiency in energy supply systems.
46. Characteristics of electric power facilities by energy intensity and energy saving potential. Directions for reducing energy costs.
47. Priority areas, activities and technologies for energy saving in electric power systems and their characteristics by types of activity: electricity generation, transportation and distribution of electricity, electricity consumption.
48. Characteristics of competitive energy market models. Reasons for creating a wholesale electricity market.
49. Nuclear energy problems. How will the NPP affect energy stability? Will there be stable electricity tariffs?
50. Thermal energy on organic fuel. Hydropower. Ocean energy conversion plants. Geothermal energy. Nuclear energy. Wind energy. Solar energy.

3. The program of the entrance exam in Module 3 «Programming of industrial controllers», «Design of electric drive systems».
(list of exam questions).

1. Operation of industrial logic controllers with analog input signals, standard input signal ranges.
2. ESC 61131-3 standard, general information about programming languages of industrial controllers.
3. FBD (functional block diagrams), LAD (relay-contact automation) language.
4. The structure of a modern industrial controller.
5. Interfaces of industrial controllers.
6. Types of inputs and outputs of industrial controllers.
7. High-performance industrial logic controllers.
8. Physical interfaces of industrial networks.
9. Standardization of signals. Operating conditions of industrial logic controllers.
10. The main differences between an industrial computer and industrial controllers.
11. Basic requirements for industrial logic controllers.
12. Distributed control systems with industrial logic controllers.
13. The design of industrial logic controllers.
14. Programmable controller SIEMENS Simatic S7-300. The nomenclature and the composition of the modules.
15. Degrees of protection of industrial logic controller enclosures.
16. IBM-compatible logic controllers.
17. Standard interfaces RS-232, RS-422, RS-485.
18. Real-time modes and limitations on the use of industrial logic controllers.
19. Industrial networks.
20. The main disadvantages of PC-based control systems (personal computers).
21. Features of unified current signals.
22. The LD programming language.
23. AC current measurement modules.
24. Standardization of input signals of industrial logic controllers.
25. DC current measurement modules.
26. Industrial networks, their features and main differences from office networks.
27. The main advantages and disadvantages of serial data transmission.
28. Historical review, current state and prospects of development of equipment of electrotechnical complexes.
29. The purpose and classification of the components of the equipment of electrical complexes and the requirements for them.
30. Power switching equipment.
31. Controlled power converters of electric energy as elements of equipment of electrotechnical complexes.
32. Electromechanical energy converters.
33. Classification and general characteristics of sensors in an electric drive.
34. Equipment for protection and alarm circuits.
35. Electrical, mechanical, thermal and structural calculations of insulating structures.
36. Technical specifications of cables and wires.
37. Protective protection against electrical corrosion.
38. Power cables up to 1000 V, types, design, scope of application.
39. High-voltage cables (over 1000 V), types, design, scope of application
40. Digital communications in the management of electric power facilities. Information and communication.
41. Digital communications in the management of electric power facilities. A model of the communication process.

42. Digital communications in the management of electric power facilities.

43. Communication in the management of technical processes.

1. Digital communications in the management of electric power facilities. Hierarchical structure of technical processes.

2. Digital communications in the management of electric power facilities. Protocols of automated electric power facilities.

46. System integration in the electric power industry. Integration of electric power industry systems.

47. System integration in the electric power industry. Levels of integration.

48. System integration in the electric power industry. Choosing the integration level.

49. Describe the programming language on which the ST language is based.

50. Describe the levels of use of industrial controllers in the automation process and what functions they perform.