NJSC " ABYLKAS SAGINOV KARAGANDA TECHNICAL UNIVERSITY"

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PROGRAM
ENTRANCE EXAM
for admission to a specialized doctoral program
Educational program 8D07104 - "Electric Power Engineering"

Department: Automation of production processes
Compiled by: Associate Professor, PhD Ivanov V.A.

Entrance exam program for the educational program
8D07104 - "Electric Power Engineering" was developed by Associate Professor , PhD, Ivanov V.A.

Discussed at the meeting of the Department of APP
Protocol No. 16 dated April 08, 2025

Head of the Department of APP_____Yugay V.V.

List of topics for Module 1 " Modern aspects of electric power industry " .

Disciplines:

1.1 "Modern theories, methods and means of creating automation and control systems."

Subject:

Modern control theory and systems theory. Mathematical research methods . Methods of analysis and synthesis of control systems under conditions of incomplete certainty. Methods of description of control objects in coordinates of state space. Observability. Identifiability. Controllability. Adaptability. Stability of processes in state space. Methods of absolute stability theory. Design stages and composition of automation and control system projects. Technologies for increasing the reliability of automated electric drive and automation systems.

References

1. Methods of classical and modern theory of automatic control: Textbook in 5 volumes; 2nd edition, revised and enlarged . Vol. 5: Methods of modern theory of automatic control / Ed. by K.A. Pupkov, N.D. Egupov. — Moscow: Publishing House of Bauman Moscow State Technical University, 2004 — 784 p.
2. Dorf R, Bishop R. Modern control systems. M: Laboratory of Basic Knowledge. Unimedia-Tile. 2002. - 831 p.
3. . Feshin B.N. Systems of operational dispatch control of automated technological complexes: Textbook. manual. / B.N. Feshin, G.I. Parshina,; Karaganda State Technical University. - Karaganda: Publishing house of KarSTU, 2017. - 97s.
4. Control and monitoring systems of automated technological complexes: Part 1. Textbook. / B.N. Feshin, K.M. Tokhmetova; Karaganda State Technical University. - Karaganda: Publishing house of KarSTU, 2017. - 107 p.
5. Dyakonov V.V. Computer control of technological process, experiment , equipment. - M.: Goryachaya Liniya-Telecom, 2009.- 608 p.
6. .Goodwin G.K., Grebe S.F., Salgado M.E. Design of control systems. - M.: Binom. Laboratory of knowledge, 2004.
7. Krasovsky A.A. Handbook of Automatic Control Theory. - M.: Nauka, 2021. - 712 p.

1.2 "Energy-saving technologies in electric power engineering and automation".

Subject:

Energy saving and energy efficiency. Basic concepts and definitions. Energy management. Energy audit. Energy service contracts as a mechanism for financing energy efficiency improvement measures. Modern energy-saving and resource-saving technologies .

References

1. Sibikin Yu. D. Energy saving technology [Electronic resource]: textbook / Yu. D. Sibikin. - Moscow: Publishing house 'FORUM', 2013. - 352 p. - (Professional education). - ISBN 978-5-91134-596-9. - Access mode: http://znanium.com/go.php?id=400962
2. Twidell J. Renewable Energy Resources [Text] / J. Twidell, A. Weir; trans. from English by V. A. Korobkova. - Moscow: Energoatomizdat, 2020. - 408 p.: ill. - Bibliography : pp. 386-387. - Title and author of the original: Renewable energy resources / JW Twidell, AD Weir. - In trans. - ISBN 5-283-02469-5 (Russian), 1990. - 392 p. - ISBN 0-419-12000-9 (English).
3. Protasevich A. M. Energy saving in heat and gas supply systems, ventilation and air conditioning [Electronic resource]: study guide / A. M. Protasevich. - Moscow: OOO 'Scientific Publishing Center INFRA-M', 2013. - 286 p. - ISBN 978-5-16-005515-2. - Access mode: http://znanium.com/go.php?id=405334.

4. Merker, E. E. Energy saving in industry and exergy analysis of technological processes. Study guide / E. E. Merker. - M.: TNT, 2014. - 316 p.
5. Evaluation of economic efficiency of energy saving. Theory and practice. - M.: Teploenergetik, 2015. - 400 p.
6. Sviderskaya, O. V. Fundamentals of energy saving. - M.: TetraSystems, 2016. - 176 p.
7. Smagulova K.K., Breido I.V., Sagitov P.I. Energy-saving technologies in automation and electric power industry: textbook. manual. - Karaganda: Publishing house of KarSTU, 2017. - 102 p. ISBN 978-601-315-254-7
8. Avdeev L.A. Energy-saving technologies in coal mines: monograph / Karaganda State Technical University. - Karaganda: Publishing house of KarSTU, 2018. - 159 p. ISBN 978-601-315-496-1
9. Arutyunyan, A. A. Fundamentals of energy saving: monograph. - M.: Energoservis

2. List of topics for Module 2 “Scientific and technical problems of energy” .

Disciplines:

2.1 "Identification and modeling of systems"

Subject:

Mathematical modeling as a means of understanding and analyzing technical systems. Purpose, types and functions of models. 3. Tasks of studying electrical systems using mathematical and simulation modeling methods. Identification. Basic concepts and definitions. Features of technological processes as objects of modeling and identification. Concepts of methods for identifying technical systems in static modes. Concepts of methods for identifying technical systems in dynamic modes. Methods for obtaining and forms of presentation of mathematical models of dynamic systems. Analytical methods for determining the dynamic characteristics of objects. Analytical methods for modeling objects with lumped parameters.

References

1 Ordyntsev V.M. Mathematical description of automation objects. - M.: Mechanical Engineering , 2019. - 360 p.
2 Basharin A.V., Novikov V.A., Sokolovsky G.G. Electric drive control: Textbook for universities. - L.: Energoatomizdat. Leningrad branch, 2017.- 392 p.
3 Deich A.M. Methods of identification of dynamic objects. - M.: Energy, 2019. - 240 p.
4 Rotach V.Ya. Calculation of the dynamics of industrial automatic control systems. Moscow: Energy, 2020. – 440 p.
5 Mathematical modeling of elements and systems of automated AC electric drives.
6 Feshin B.N. et al. Computer modeling and identification of electrical complexes: Textbook. In 3 parts – Karaganda: Publishing house of KarSTU, 2010. – 98 p.

2.2 "Theory of Experiment".

Subject:

Classification, types and objectives of the experiment. Single-factor and multi-factor experiment. Statistical processing of experimental research results. Statistical, null, alternative hypotheses. Similarity and modeling in scientific research. Similarity theorems. Types of models: conceptual, cybernetic, electronic, physical, analog, mathematical . Main tasks of mathematical statistics. Concepts of confidence probability and significance level. Normal distribution law. General algorithms for solving the main problems of mathematical statistics. Factors in an experiment. Types of factors – variable, unchangeable, random. Requirements for variable factors . Statistical criteria

and their application . Analysis of variance. 19. Regression analysis .

References

1 Safin, R. G. Fundamentals of Scientific Research. Organization and Planning of Experiment: a tutorial / R. G. Safin, N. F. Timerbaev, A. I. Ivanov; Ministry of Education and Science of the Russian Federation, Kazan National Research Technological University. - Kazan: KNITU, 2013 - 154 p.

2 Spirin, N. A. Methods of planning and processing the results of an engineering experiment: a tutorial / N. A. Spirin, V. V. Lavrov, L. A. Zainullin [et al.]. - Ekaterinburg: UINTs, 2015 - 290 p.

3 Zadorozhnaya, E.A. Theory of experimental planning: a tutorial – Chelyabinsk: Publishing center of SUSU, 2018. – 92 p.

4 Sidnyaev, N.I. Theory of experimental design and analysis of statistical data: a textbook for masters / N.I. Sidnyaev. - 2nd ed., revised and enlarged. - M .: Yurait Publishing House, 2015. - 495 p. - Series: Master.

5 Boyarshinova, A.K. Theory of engineering experiment: text of lectures / A.K. Boyarshinova, A.S. Fisher. - Chelyabinsk: Publishing house of SUSU, 2006. - 85 p.

6 Kholian, A.M. Introduction to engineering research / A.M. Kholian, M.P. Rudnitsky. - Sverdlovsk: UPI, 1984. - 96 p.

7 Engineering experiment: textbook / compiled by V.I. Lyashkov. Tambov: TSTU, 2014. – 81 p.

8 Mukhachev, V.A. Planning and processing of experimental results: Tutorial. / V.A. Mukhachev. – Tomsk: Tomsk State University of Control Systems and Radioelectronics, 2007. – 118 p.

9 12. Ventzel, E.S. Probability Theory / E.S. Ventzel. - 4th. ed. - M .: Nauka, 1969. - 576 p.

10 Lyashkov, V.I. Engineering experiment: textbook / compiled by V.I. Lyashkov. – Tambov: TSTU, 2014. –81 p.

2.3 "Electric drive control systems".

Subject

Classification of automatic control systems of electric drives and automated control systems of electric drives. Logical control of electric drives. Typical units of control and protection circuits. Typical relay-contactor. automatic control circuits of electric drives. Principles of control of electric drive coordinates. Typical control modes of mechanisms. Stabilization, tracking, positioning. Control systems of interconnected electric drives of continuous-flow production . Basic equation of motion of electric drives.

References

1. Control systems of electrical engineering complexes: a textbook for students and masters of specialties 6M070200-"Automation and control", 6M071800 - "Electric power engineering", "Control systems of electrical engineering complexes", "Control systems of electric drives" / I. V. Breido, L. M. Lapina; Ministry of Education and Science of the Republic of Kazakhstan, Karaganda State Technical University, Department of "Automation of production processes". - Karaganda: KarSTU, 2018. - 94 p.: ill. - (Rating). - ISBN 978-601-315-472-5

2. Control systems for electrical engineering complexes: a textbook for students, master's degree students of the specialty 6M071800 "Electric Power Engineering", 6M070200 "Automation and Control" / I. V. Breido, L. M. Lapina. - Almaty: Cyber Smith, 2018. - 122 p.: ill. - (Rating). ISBN 978-601-310-519

3. Control and monitoring systems of automated technological complexes (part 2): textbook / B.N. Feshin, K.M. Tokhmetova; Karaganda State Technical University. - Karaganda: Publishing house of KarSTU, 2018. 100 p. ISBN 978-601-315-460-2

4. Control and monitoring systems of automated technological complexes (part 1): textbook / B.N. Feshin, K.M. Tokhmetova; Karaganda State Technical University. - Karaganda: Publishing house of KarSTU, 2017. - 107 p. ISBN 978-601-315-347-6
5. Automated control systems for electric drives /G.I. Gulkov et al. - Minsk: New knowledge, 2007. - 395 p.
6. Creation and operation of automated systems: a textbook for master's and doctoral students specializing in "Automation and Control" and "Electric Power Engineering" / L. A. Avdeev; Ministry of Education and Science of the Republic of Kazakhstan, Karaganda State Technical University. - Karaganda: KarSTU, 2014. - 128 p. - (Rating). ISBN 978-601-296-774-6

2.4 "Modeling of electric drives".

Subject

Elements of the adjustable electric drive features of simulation modeling. MATLAB Simulink libraries simulation methods. Simulation of power supply systems of the adjustable electric drive. Simulation of the mechanical part of the adjustable electric drive. Simulation of the control system of the electric drive.

References

1. Ordyntsev V.M. Mathematical description of automation objects. - M.: Mechanical Engineering, 2019. - 360 p.
2. Basharin A.V., Novikov V.A., Sokolovsky G.G. Electric drive control : Textbook for universities. - L.: Energoatomizdat. Leningrad branch, 2017.- 392 p.
3. Deich A.M. Methods of identification of dynamic objects. - M.: Energy, 2019. - 240 p.
4. Rotach V.Ya. Calculation of the dynamics of industrial automatic control systems. Moscow: Energy , 2020. - 440 p.
5. Dyakonov V.P. MATLAB 6/6.1/6.5. / Edited by V.B. Yakovleva. M.: Higher School, 2016.– 263 p.
6. Terekhin V.B. Computer modeling of AC and DC electric drive systems in Simulink: tutorial /V.B. Terekhin, Yu.N. Dementyev: Tomsk Polytechnic University. - Tomsk: Publishing house of Tomsk Polytechnic University, 2015. - 307 p.
7. Pogoditsky O.V., Malev N.A., Akhunov D.D., Tsvetkov A.N. Calculation and modeling of electric drives with regulators of various configurations: laboratory practical training. Kazan: Kazan. state power engineering university, 2015 – 156 p.
8. Migdalenok, A.A. Modeling of an electric drive on a computer: a teaching aid for students majoring in 1-53 01 05 “Automated electric drives”: in 2 parts / A.A. Migdalenok. – Minsk: BNTU, 2010 – Part 2 – 94 p.

3. List of topics for Module 3 “Automation and design of facilities in the electric power industry” .

Disciplines:

3.1 "Programming industrial controllers".

Subject:

Methods of programming industrial controllers according to IEC 61131. Systematization of automation equipment using computer-aided design technologies. Creation of control systems. Combinational logic, creation of a control program according to a given algorithm. Basics of working in the PLC programming software environment. Establishing communication with the controller. 1. Symbolic addressing instead of absolute addressing. Data types and indirect access to

elements. Access to input/output areas using PLC data types. Library types and library elements. Graphic and text built-in editors of PLC programming environments. Debugging tools for PLC programming environments.

References

1. Nesterov, K. E. N56 Programming industrial controllers: a teaching aid / K. E. Nesterov, A. M. Zyuzev. - Ekaterinburg: Publishing house of the Ural. University, 2019 - 96 p.
2. Petrov I. V. Programmable controllers. Standard languages and techniques of applied design; ed. V. P. Dyakonova / I. V. Petrov - M.: SOLON-Press, 2016. - 255 p.
3. Hoffman, P. M. Industrial Controller Programming Tools. SFC: study guide / P. M. Hoffman, P. A. Kuznetsov, V. V. Losev;. – Krasnoyarsk: Siberian State University named after M. F. Reshetnev 2019. – 84 p.
4. Sergeev, A. I. Programming of automation system controllers: a tutorial / A. I. Sergeev, A. M. Chernousova, A. S. Rusyaev. – Orenburg: OSU, 2016. – 125 p.
5. Antipin M.E. Programming industrial controllers: Tutorial / M.E. Antipin, Yu.O. Loboda. - Tomsk: Tomsk. state University of control systems and radioelectronics, 2023 - 80 p.
6. Parshina G. I. Software for industrial controllers: a tutorial. In 2 parts . – Karaganda: KarSTU, 2018. - 110 p.

3.2 "Automation of electrical complexes"

Subject:

Automation of electrical engineering complexes. Main goals and tasks of automation. Levels of automation. Advantages and disadvantages of automation systems. Technical means of automation systems. Software means of automation systems. Technologies for increasing the reliability of automation systems. State system of industrial devices and automation equipment. Groups of technical automation equipment. Organization of communication with a technological control object. Devices for communication with the object. Types of information about a technological process or a control object. Automation of continuous and discrete technological processes.

References

1. Automation of standard technological processes and installations: Textbook for universities / A.M. Korytin, N.K. Petrov, S.N. Radimov, N.K. Shaparev. – M.: Energoatom-izdat, 2020. – 432.
2. Ordyntsev V.M. Mathematical description of automation objects. - M.: Mechanical Engineering, 2019. - 360 p.
3. Design of automation systems for technological processes: Reference manual / [A.S. Klyuev, B.V. Glazov, A.Kh. Dubrovsky, A.A. Klyuev] ; Ed . A.S. Klyuev. – M.: Energoatomizdat, 2018. – 464 p.: ill.
4. Shishmarev V.Yu. Typical elements of automatic control systems: textbook. - M .: ACADEMIA, 2019. - 304 p.
5. Ivanov, A.A. Automation of technological processes and production: Textbook - M .: Forum, 2020. - 224 p.
6. Meltser, M.I. Development of automated control system algorithms / M.I. Meltzer. - M.: Statistics, 2014. - 240 p.
7. Starostin, A. A. Technical means of automation and control: textbook / A. A. Starostin, A. V. Lapteva. - Ekaterinburg: Publishing house of the Ural. University, 2015. - 168 p.
8. Egorov, G.A. Control computer systems for industrial automation : Textbook / N.L. Prokhorov, G.A. Egorov, V.E. Krasovsky; Ed. N.L. Prokhorov, V.V. Syuzev. - M.: MSTU im. Bauman, 2012. - 372 p.
9. Gusev N.V., Lyapushkin S.V., Kovalenko M.V. Automation of technological complexes and systems in industry. – Tomsk: TPU. 2011. –198 p.

10. Kangin, V.V. Industrial controllers in automation systems of technological processes: Text-book / V.V. Kangin. - St. Oskol: TNT, 2013. –408 p.

Examination Questions

According to Module 1 (50 questions).

1. The concept of "Electric Power Engineering". Objects of analysis and research in the specialty "Electric Power Engineering". Electrical complexes. Electrical systems.
2. Classification of electrical complexes and electrical systems.
3. Modern control theory. Mathematical research methods.
4. Methods of analysis and synthesis of control systems under conditions of incomplete certainty.
5. Methods for describing control objects in state space coordinates.
6. Observability. Identifiability. Controllability. Adaptability.
7. Stability of processes in state space. Methods of absolute stability theory.
8. Robust and invariant systems. Classification of robust control systems. Uncertain control systems. Robust stability.
9. Basic approaches to the analysis and synthesis of automatic and automated control systems.
10. Feedback Synthesis Methods. Elements of Stabilization Theory
11. Quality of control processes in linear dynamic systems.
12. Control under disturbances. Different types of disturbances: operator, coordinate. Tracking systems.
13. Absolute stability. Geometrical and frequency criteria of absolute stability.
14. Main types of nonlinearities in control systems. Methods of studying the behavior of nonlinear systems.
15. Self-oscillations of nonlinear systems. Control of systems with aftereffect.
16. Methods and algorithms for identification of dynamic systems.
17. Criteria for control optimization. Some general methods of optimal control theory. Optimal control algorithms. Optimization of dynamic systems.
18. Algorithms of adaptive automatic control systems. Method of recurrent target inequalities in adaptive control.
19. Extreme control systems. Methods and algorithms of estimation in correlation-extreme systems.
20. Methods of sensitivity theory.
21. Search methods of automation. Automation of design of automatic control systems .
22. Optimal and adaptive control.
23. Characteristics of the quality of electric power. The influence of the quality of electric power on the operation of electrical receivers.
24. Electricity quality control. Automated systems for recording and measuring electricity consumption parameters. Methods and technical means for ensuring electric power quality.
25. Systems for collecting and processing information. Concentrated, hierarchical and distributed systems. Intelligent systems. Structure, main characteristics
26. General issues of energy saving economics.
27. Energy management. 3. Energy audit.
28. Energy surveys and energy audits of energy consuming facilities.
29. Energy service contracts as a mechanism for financing measures to improve energy efficiency.
30. Modern energy-saving and resource-saving technologies.
31. Energy efficiency and energy saving indicators.
32. Prospects for the use of new types of fuel and the development of renewable energy sources.
33. Ways to reduce energy consumption when using electric drives.
34. Automation of technological processes based on a controlled electric drive as a means of resource and energy conservation. The main ways to increase the energy efficiency of electric drives .
35. Saving electricity in electrical networks.

36. Saving electricity in transformers

37. Saving electricity in electric motors.

38. State policy for increasing energy efficiency

39. Saving energy in pumping and blowing units using a variable speed electric drive.

40. Saving energy in lighting systems.

41. Saving electricity in electrical engineering installations

42. Principles of construction of energy storage devices using non-traditional sources of electrical energy.

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

44. Energy and technological possibilities and prospects for the use of non-traditional and renewable energy sources for the energy supply of integrated and autonomous consumers.

45. Problems of electric power transmission in trunk networks. Problems of electric power transportation in distribution networks. Problem of ensuring the transmission capacity of electric networks of different classes of nominal voltage. New tasks and objects of control in electric networks.

46. Reactive power flow management in electric networks. The problem of electric power quality during its transmission and distribution. Transfer of networks to new generation power lines and equipment. Main trends in the development of electric networks.

47. 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.

48. Environmental aspects of energy saving

49. Legislation of the Republic of Kazakhstan in the field of energy saving and increasing energy efficiency

50. Principles and criteria for assessing economic indicators of energy saving.

Module 2 (50 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 for identifying 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. Modeling theory. System and system elements. Concept of a model. Objectives of modeling
11. Information model. Stages of construction of the information model.
12. Modeling of dynamic systems by the method of reducing the order of the derivative in the environment of problem-oriented application packages.
13. Classification of models by area of use and by the nature of the mathematical apparatus used. Classification of models by the time factor, by taking into account random factors, by subject area. Classification of models by form of presentation
14. MATLAB-SIMULINK software system. Extensions of MATLAB software for identification of dynamic objects and systems.
15. Symbolic modeling software system MathCAD.
16. Adaptive systems for automatic control of technical objects with modeling and identification loops.
17. .The concept of modeling control objects. Types of modeling. Basic terms in mathematical modeling. Classification of models. Basic operators of models of control objects. General principles of constructing models
18. Analytical methods for determining the dynamic characteristics of objects. Analytical methods for modeling objects with concentrated parameters.
19. Approximation of an object model by dynamic links. Identification of a control object by direct methods. Parametric identification. Nonparametric identification of dynamic objects.
20. Construction of a conceptual model of the system and its formalization. Algorithmization of the model. Principles of construction of modeling algorithms. Forms of presentation of modeling algorithms
21. Classification, types and objectives of the experiment. Single-factor and multi-factor experiment.
22. Basic principles and concepts of probability theory and mathematical statistics. Random events, probability of an event.
23. Theory of random errors. Processing of experimental data of measurement results. Fundamentals of the theory of random errors.
24. Statistical processing of experimental research results. Statistical, null, alternative hypotheses.
25. Similarity and modeling in scientific research. Similarity theorems. Types of models: conceptual, cybernetic, electronic, physical, analog, mathematical.
26. Requirements for the optimization parameter. Types of optimization parameters. Statistical analysis. The concept of experimental design. Optimization parameter and response function. Variance of the optimization parameter.
27. Main tasks of mathematical statistics. Concepts of confidence probability and significance level. Normal distribution law. General algorithms for solving main tasks of mathematical statistics.

28. Statistical criteria and their application. Student's and Pearson's distributions. Testing the homogeneity of variances and observations. Fisher's and Cochran's distributions, t-criterion.

29. Processing the experimental results. Least squares method. The simplest methods for constructing a generalized response. Generalization of the least squares method to a multifactorial one.

30. Definition of a factor. Requirements for factors when planning an experiment. Factors in an experiment. Types of factors – variable, unchangeable, random. Requirements for variable factors. Properties of a full factorial experiment of type 2k.

31. Checking the adequacy of the model. Adequacy of the mathematical model. Making decisions after constructing a process model. Minimizing the number of experiments.

32. Full factorial experiment and mathematical model. Implementation of the experimental plan. Interpretation of results.

33. Statistical criteria and their application. Student's and Pearson's distributions. Testing the homogeneity of variances and observations. Fisher's and Cochran's distributions, t-criterion. Significance criteria.

34. Analysis of variance as a means of detecting influencing factors against the background of random noise. One- and two-factor analysis of variance in the absence of information on the degree of influence of random factors. Analysis of variance under conditions of heterogeneity.

35. Regression analysis as a means of constructing mathematical models of objects subject to random influences. Tasks of regression analysis. The essence of linear and nonlinear regression.

36. Main stages of regression analysis. Types of regressions. Determining the coefficients of univariate regression based on the least squares method. Formulas for calculating the coefficients in the equation of simple linear regression.

37. Logical control of electric drives. Typical units of protection circuits.

38. Principles of electric drive coordinate control. Standard settings of the simplest contours.

39. Typical modes of mechanism control. Stabilization, tracking, positioning.

40. Synchronization of speeds and positions. Electric drive load control.

41. Principles of constructing automatic control of an adjustable electric drive. Calculation schemes of an automated electric drive. The main equation of electric drive motion.

42. Technical means of automated electric drive systems. Software for automated electric drives.

43. Calculation of operating modes. Selection of automated electric drives.

44. Modeling of power supply systems of an adjustable electric drive.

45. Modeling of the mechanical part of an adjustable electric drive.

46. Elements of an adjustable electric drive features of MATLAB simulation. Simulink and Simpower Systems libraries.

47. Modeling of DC electric motors with series, independent and mixed excitation.

48. Modeling of an asynchronous electric motor with a squirrel-cage rotor, with a phase rotor.

49. Modeling of a synchronous electric motor.

50. Modeling of an electric drive control system.

Module 3 (50 questions)

1. Operation of industrial logic controllers with analog input signals, standard input signal ranges.
2. IEC 61131.3 standard - General information on programming languages for industrial controllers.
3. Structure of a modern industrial controller. Interfaces of industrial controllers. Types of inputs and outputs of industrial controllers.
4. Performance of industrial logic controllers. Physical interfaces of industrial networks. Standardization of signals. Operating conditions of industrial logic controllers.
5. Basic requirements for industrial logic controllers. Structural design of industrial logic controllers.
6. Distributed control systems with industrial logic controllers. .Standard PLC interfaces.
7. Real-time modes and limitations of industrial logic controllers.
8. Standardization of input signals of industrial logic controllers.
9. Industrial networks, their features and main differences from office networks.
10. To identify the main features of designing systems and automation tools using application environments for PLC programming.
11. Creation of control systems. Combination logic, creation of a control program according to a given algorithm.
12. Symbolic addressing instead of absolute addressing. Data types and indirect access to elements
13. Accessing I/O areas using PLC data types. Selective access
14. Library Types and Library Elements
15. Graphic and text built-in editors of PLC programming environments. Debugging tools for PLC programming environments.
16. PLC programming environment project management tools. PLC programming environment project recovery tools.
17. Variable declaration operators. Global and local variables. Controller configuration. Assigning controller inputs/outputs
18. Description of the operation of counters. Description of the purpose, type of input and output signals. Example of using counters. Examples of program code with counters in FBD, IL, ST languages.
19. Description of operation of timers with turn-off delay. Description of purpose, type of input and output signals. Example of timer use. Examples of program code with timers in FBD, IL, ST languages
20. Description of the operation of timers with a turn-on delay. Description of the purpose, type of input and output signals. Example of using a timer. Examples of program code with timers in FBD, IL, ST languages
21. Creating visualization in the environment. Examples of connecting buttons, analog and discrete values.
22. Static/dynamic signals. Description and use of static and dynamic signals in LD, FBD, ST languages.
23. Calling function blocks. Applying instructions.
24. Arithmetic operators. Modifiers. Branching operators. Comparison operators. Call operators.
25. Integer data. Description, characteristics, application. Real variables. Description, characteristics, application.
26. The main software components of the controller programming environment.
27. Universal systems for PLC programming Specialized systems for PLC programming Tools for PLC programming complexes.
28. PLC programming suite tools. Graphic and text built-in editors of PLC programming environments.

29. PLC programming environment debugging tools. PLC programming environment project management tools. PLC programming environment project recovery tools.

30. Variable declaration operators. Global and local variables. Controller configuration. Assigning controller inputs/outputs

31. Technical means of automation systems. Software means of automation systems. Technologies for increasing the reliability of automation systems.

32. Automation of electrical engineering complexes. Main goals and tasks of automation. Levels of automation. Advantages and disadvantages of automated systems

33. Main components of ACS TP (automated process control system). Software for automation

34. State system of industrial devices and automation equipment. Groups of technical automation equipment.

35. Types of automatic devices. Elements of automation systems. Classification of automatic systems.

36. Technological information. Means of collecting information on the progress of the technological process. Transformation of technological information. Types and forms of signals.

37. Automatic devices. Classification and their features. Types, classification and purpose of ACS (SAR).

38. Levels of ACS TP. Structural diagram of ACS TP or ACS TO. Functions and characteristics of ACS elements

39. .Sensors . Classification of sensors.

40. Algorithmization of maintenance. Types and methods of algorithmization.

41. Measuring instruments and converters. Construction principles.

42. Logical scheme of the algorithm. Construction principles.

43. Functional diagram of automation. Construction principles..

44. Organization of communication with the technological control object. Devices for communication with the object. Means of using command information (actuators, power amplifiers).

45. Automation of continuous and discrete technological processes.

46. Search methods of automation. Automation of design of automatic control systems . Methodology of analysis of technological process as an object of control.

47. Typical schemes for automated regulation of process variables (flow, pressure, temperature, level, concentration, etc.).

48. General concept of a complex system. Classification of complex systems.

49. Signaling. Types and methods of signaling in automated process control systems.

50. ACS in APCS. Standard laws of automatic regulation