NJSC " ABYLKAS SAGINOV KARAGANDA TECHNICAL UNIVERSITY"

Scientific and Methodological Council
Protocol No. 5
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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. 12 dated February 03, 2026

Head of the Department of APP Yugay V.V.

Topic 1 " Modern aspects of electric power industry " .

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

Topic2. "Scientific and technical problems of energy".

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.

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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. Topic 3 "Automation and design of facilities in the electric power industry".

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: Textbook / V.V. Kangin. - St. Oskol: TNT, 2013. –408 p.