NATIONAL TECHNICAL UNIVERSITY OF UKRAINE
"Igor Sikorsky Kyiv Polytechnic Institute"

FACULTY OF ELECTRIC POWER ENGINEERING AND AUTOMATICS

APPROVED by
Academic Council of
Faculty of electric power engineering and automatics
Protocol No. ____ from February 26, 2020

Chairman of the Academic Council

_____Olexandr YANDULSKY

PROGRAM

of complex professional examination
for admission of foreign citizens to master's degree program
"Electrotechnical devices and electrotechnological complexes"
specialty 141 ***Electric power engineering, electrical engineering and electromechanics***

The program is recommended by
Department of theoretical electrical engineering
Protocol No. 6 from January 22, 2020

Head of Department

_____ Mykola OSTROVERKHOV

Kyiv – 2020

INTRODUCTION

Complex professional examination for admission to the master's degree program "Electrotechnical devices and electrotechnological complexes" according to specialty 141 *Electric power engineering, electrical engineering and electromechanics* is aimed at revealing knowledge and skills in educational program for further training.

The test takes place in the form of a written work lasting 1 hour 30 minutes. Each examination task has three theoretical questions on the main courses of educational program. After writing the work, the commission checks them and gives ratings in accordance with the evaluation criterion.

MAIN PART

1. Theoretical fundamentals of electrical engineering

1. Passive and active elements of the electric circuit and their parameters.
2. Kirchhoff's laws for voltages and currents.
3. The relationship between currents and voltages of the branches of an electric circuit (Ohm's law).
4. The method of loop currents.
5. The method of nodal potentials.
6. The principle of superposition.
7. Equivalent conversions in electrical circuits.
8. The equivalent generator method.
9. Power in a circle of a sinusoidal current. Power factor.
10. Power in an integrated manner. Comprehensive capacity balance.
11. A complex method for calculating electrical circuits.
12. Complex resistance and conductivity. Writing the Ohm's law and Kirchhoff's laws in a complex form.
13. The calculation of electrical circuits in series connection of sections of the circuit.
14. Calculation of electrical circuits with parallel connection of sections of the circuit.
15. The calculation of electrical circuits in the mixed connection of sections of the circuit.
16. The calculation of the electrical circuit based on the star-delta conversions.
17. Parameters of inductively coupled elements. Magnetic coupling coefficient. Poles of the same name inductively coupled elements.
18. The resonant state of the electrical circuit. General resonance condition.
19. Voltage resonance.
20. Current resonance.
21. The practical significance of resonance in electrical circuits. Electric filters.
22. Symmetric three-phase electromotive forces (EMF) systems of direct, reverse and zero sequence.
23. The calculation of three-phase circuits in the general case of asymmetry of electromotive forces (EMF) and asymmetry of the circle.
24. The power of the three-phase circle and its measurements.
25. Initial conditions and laws of switching.
26. Transient, steady-state and oscillating processes.
27. The classic method of calculating transients.
28. Transients in the circuits R, L and R, C.
29. Characteristics of sinusoidal electromotive forces (EMF), voltages and currents.

30. Image of sinusoidal electromotive forces (EMF), voltages and currents using rotating vectors. Vector charts.
31. The current and average values of periodic electromotive forces (EMF), voltages and currents.
32. Electric circuits with distributed parameters. Electrical circuits with intermediate parameters.
33. Topological concepts of circuitry. Scheme graph.
34. Equivalent parameters of a complex alternating current circuit, which is generally regarded as a two-terminal network.
35. Two-terminal equivalent circuit at a given frequency.

2. Electrical apparatus

36. What are the differences between work and arcing contacts?
37. What are the main reasons that cause contact wear and tear? What factors depend on the contact wear and tear on the circuit? What factors affect contact wear when breaking?
38. Give methods and techniques to combat contact jitter.
39. Give methods for compensating electrodynamic forces in contact joints.
40. Give the basic materials of contact compounds and give a brief description of them.
41. Give the most common composition of arc suppression contacts made of cermet.
42. Design features and the principle of operation of oil tank switches.
43. Design features and the principle of operation of low-volume oil circuit breakers.
44. Design features and the principle of operation of air circuit breakers with closed separators.
45. Design features and the principle of operation of vacuum circuit breakers.
46. Design features and the principle of operation of electromagnetic switches.
47. Design features and the principle of operation of barely gas switches.
48. The conditions for the selection of switches.
49. The purpose of the causes of switches.
50. Design features and the principle of operation of spring actuators circuit breakers.
51. Design features and the principle of operation of electromagnetic actuators of circuit breakers.
52. Design features and the principle of operation of pneumatic circuit breaker drives.
53. Design features and operating principle of hydraulic circuit breaker drives.
54. The main advantages and disadvantages of tank switches.
55. The main advantages and disadvantages of low oil circuit breakers. Where are oil circuit breakers mainly used?
56. Design features and principle of operation of switchboards. Design features and principle of operation of switchboards.
57. What is a disconnector? What are its functions?
58. What are the characteristics of disconnectors? What are the main requirements for disconnectors?
59. What are the differences in the design of external and internal disconnectors? What caused them?
60. What is called a jumper? What is its purpose? What is the function of the separator?
61. The purpose of non-automatic switching devices.
62. Switches and their characteristics. How is the selection of knife switches made?
63. What is a fuse and its main elements? How are fuses selected?
64. What is a circuit breaker and its main elements? How are circuit breakers selected?
65. What is a disconnector? Their classification by performance.
66. What is a contactor and magnetic starter? How are contactors and magnetic starters selected?

67. Purpose and composition of the complete switchgear.
68. The advantages of complete devices compared to conventional designs of electrical installations.
69. Features of the operating mode and design of current transformers. How is a current transformer connected to the network?
70. Features of the operating mode and design of voltage transformers. The main parameters of voltage transformers.

3. High voltage engineering

71. The purpose and design features of bushings.
72. Preventive testing of insulators.
73. Operational control of insulators.
74. Overlap of insulators with contaminated and wet surfaces, as well as in the rain.
75. Features of insulation for areas with polluted atmosphere.
76. Insulation of high voltage power cables.
77. General trends in the use of high-voltage cable lines.
78. The basic principles of the structure of cable insulation.
79. Oil-filled cables.
80. Gas-filled cables.
81. Cables with plastic insulation.
82. Temperature condition of the cable and its effect on cable insulation.
83. The electric field of a single-core cable. Regulation of the electric field using grading. Single-core cable insulation grading.
84. Insulation of open switchgears. Insulation of complete switchgears.
85. General characteristics of the insulation of power transformers.
86. Monitoring the status of transformers in operation.
87. General characteristic of insulation of power capacitors.
88. What is the dielectric loss tangent?
89. Aging of insulation under the influence of partial discharges.
90. The role of partial discharges in the diagnosis of insulation of electrical installations.
91. Change in dielectric strength of the insulation during aging.
92. Split wires and shielding. Spherical and toroidal screens for high voltage structures.
93. Lightning as a source of lightning surge. Electrical characteristics of lightning.
94. Protection of substations from direct lightning strikes.
95. Lightning conductor and its principle of action. Lightning conductor protection zones.
96. Design of lightning rods. Rod and cable lightning rods.
97. Protective devices and apparatus. Protective gaps and tubular arresters.
98. Protective devices and apparatus. General characteristics of valve arresters and surge arresters.
99. Voltage-current characteristic of a surge arresters.
100. General principles of lightning protection of overhead power lines.
101. General characteristics of high voltage test installations.
102. Test transformers and test methods for insulation of industrial frequency voltage.
103. Impulse voltage generators.
104. Pulse current generators.
105. Diagnostics of electrical installations using infrared technology. Features of the use of thermal imagers and pyrometers.

FINAL PART

EVALUATION CRITERIA FOR COMPLEX PROFESSIONAL EXAMINATION

On the exam, students perform a written test. Each task contains three theoretical questions. The first question is estimated at 34 points, the second

and the third - 33 points.

The evaluation system of the first theoretical question:

- "excellent", full answer (at least 90% of the required information) - 32-34 points
- "very good", a fairly complete answer (at least 85% of the required information), or a complete answer with minor inaccuracies - 29-31 points
- "good", a fairly complete answer (at least 75% of the required information) with the inaccuracies present - 25–28 points
- "satisfactory", incomplete answer (at least 65% of the required information) and minor errors - 2 2 -24 points
- "enough", incomplete answer (at least 60% of the necessary information) and minor errors - 20-21 points
- "unsatisfactory", unsatisfactory answer (less than 60% of the required information), or contains significant errors - 0 points.

The evaluation system of the second and third theoretical questions:

- "excellent", full answer (at least 90% of the required information) - 32-33 points
- "very good", a fairly complete answer (at least 85% of the required information), or a complete answer with minor inaccuracies - 28-31 points
- "good", a fairly complete answer (at least 75% of the necessary information) with inaccuracies - 24-27 points
- "satisfactory", incomplete answer (at least 65% of the required information) and minor errors - 22-23 points
- "sufficient", incomplete answer (at least 60% of the necessary information) and minor errors - 19-21 points
- "unsatisfactory", unsatisfactory answer (less than 60% of the required information), or contains significant errors - 0 points.

The sum of the points for three questions is transferred to the examination score according to the table:

Number of points	Assessment
95-100	Excellent
85-94	Wery good
75-84	Good
65-74	Satisfactory
60-64	Sufficient
Less than 60	Unsatisfactory

EXAMPLE OF A TYPICAL PROFESSIONAL EXAMINATION TASK

1. Two-terminal equivalent circuit at a given frequency.
2. Features of the operating mode and design of voltage transformers. The main parameters of voltage transformers.
3. Diagnostics of electrical installations using infrared technology. Features of the use of thermal imagers and pyrometers.

RECOMMENDED LITERATURE LIST

1. Theoretical fundamentals of electrical engineering. Vol 1: Textbook for students of electrical engineering specialties of universities / V.S. Boiko [et al.]; Ed. by I. M. Chizhenko, V.S. Boiko; NTUU "KPI". - Kiev: Polytechnica, 2004. - 272 p.
2. Theoretical fundamentals of electrical engineering. Vol 2: Textbook for students of electrical engineering specialties of universities / V.S. Boiko [et al.]; Ed. by I. M. Chizhenko, V.S. Boiko; NTUU "KPI". - Kiev: Polytechnica, 2008. - 224 p.
3. Theoretical fundamentals of electrical engineering. Vol 2: Textbook for students of electrical engineering specialties of universities / V.S. Boiko [et al.]; Ed. by I. M. Chizhenko, V.S. Boiko; NTUU "KPI". - Kiev: Polytechnica, 2013. - 241 p.
4. V. A. Brzezitsky, V. Ts. Zelinsky, P. D. Lezhniuk, A. E. Rubanenko. Electric devices: a textbook / [Brzezitsky V. A., Zelinsky V. Ts., Lezhniuk P. D., Rubanenko A. E.]. - Kherson: OLDI-PLUS, 2016 .-- 602 p..
5. Brzezitsky V. A., Isakova A. V., Rudakov V. V. et al. High-voltage engineering and electrophysics: Textbook. / Ed. V. A. Brzezitsky and V. M. Mikhailov. - KharkIv: NTU "KhPI" - Tornado, 2005. - 930 p.
6. Jerusalimov M.E., Orlov N.N. High-voltage engineering / Edited by M.E. Jerusalimov. - Kiev: Kiev University Press, 1967. - 444 p.

Program developed by

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