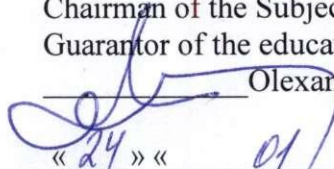


**National Technical University of Ukraine
"Igor Sikorsky Kyiv Polytechnic Institute"**

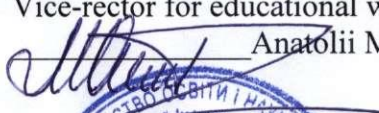
APPROVED:

Chairman of the Subject Commission
Guarantor of the educational program
Olexandr YANDULSKY


« 24 » « 01 » 2022

AGREED:

Vice-rector for educational work
Anatolii MELNYCHENKO


« 28 » « 10 » 2022



PROGRAM

ADDITIONAL ENTRANCE EXAMINATION

to obtain the degree of Doctor of Philosophy

specialty 141 Electric power engineering, electrotechnics and electromechanics

The program is recommended by academic councils of Faculty of Electric Power Engineering and Automatics, Educational and Scientific Institute of Energy Saving and Energy Management

I. GENERAL INFORMATION

An additional entrance examination for the degree of Doctor of Philosophy 141 "Electrical Power Engineering, Electrotechnics and Electromechanics" is conducted for those entrants who have a master's degree in specialties that do not relate to the field of knowledge 14 "Electrical Engineering".

Conducting an additional entrance test should reveal the adequacy of the level of basic training of the entrant in the chosen specialty for admission.

The program contains two sections:

1. Power plants, substations and networks.
2. Electrical complexes and systems, systems for providing consumers with electricity, energy management and energy efficient technologies.

Both sections of the entrance examination program contain general questions, the answer to which should be known to every specialist in the field of electrical engineering. The task of the additional entrance test consists of three theoretical questions: from the first or second sections. Additional entrance test in the specialty is conducted in the form of an exam. Duration of preparation of tasks of additional professional test - 2 academic hours. The next section of the program lists only those topics from these sections that relate to the performance of entrance examination tasks. Information on the rules of admission to training and requirements for entrants to the educational program "Electrical Power Engineering, Electrotechnics and Electromechanics" is provided on the website of Igor Sikorsky KPI: <https://pk.kpi.ua/>.

II. TASKS OF THE INTRODUCTORY TEST

1. Power plants, substations and networks. Electric power systems

1.1. Theoretical electrical engineering

General characteristics of the problems of the theory of electromagnetic field and the theory of electric and magnetic circuits. Basic equations of the electromagnetic field in integral form. Methods for calculating nonlinear electric and magnetic circuits at constant currents and voltages. Features of nonlinear alternating current circuits and methods of their calculation.

1.2. Electrical machines and devices

Dual feed machine systems. Switching processes in DC machines (DC). Ways to improve switching: additional poles, brush offset, etc. Compensation winding. Vector control of synchronous motors coordinates. Nonlinear surge arresters.

1.3. Power plants, substations and networks

Control, monitoring and signaling systems at power plants and substations. Protection against direct lightning strikes. Special types of transformers. Autotransformers and multi-winding transformers.

1.4. Power systems

The concept of power system. Classification of modes of electric power systems, requirements to them. Automatic regulation of frequency, voltage, active and reactive power. Relay protection of electrical systems, requirements and principles of operation.

1.5. Alternative and renewable energy sources

Types of wind turbines and wind turbines. Their advantages and disadvantages. Basic designs of solar collectors and photovoltaics.

2. Electrical complexes and systems, systems for providing consumers with electricity, energy management and energy efficient technologies.

2.1. Power supply of technological and technical complexes

General requirements for power supply systems. Structure of power supply systems. Requirements for reliability of power supply. Requirements for the quality of electricity. Estimated load in power supply systems. Methods for calculating electricity losses in electrical networks. Selection of conductors of electrical networks with voltage up to and over 1000 V. Reactive power. Examples and characteristics of the main consumers of reactive power. Losses are associated with the transmission of reactive power. Basic means of automation in power supply systems (automatic circuit reclosers, automatic transfer switch, automatic load shedding). Protection in power supply systems, requirements for relay protection. Classification of electrical appliances, requirements and basic parameters of electrical appliances. Reactive power sources, their brief characteristics. Structure and elements of a modern electric drive. Classification of a simple electric drive. Modes of operation of electric motors and their electromechanical characteristics. Schemes of replacement of an induction motor and equations of its electromechanical characteristic.

2.2. Energy complexes and systems

Fuel and energy complex as an integral part of the economy. Economic aspects of energy. Properties of energy systems. Fuel and energy balance. Analysis of the main losses of fuel and energy. Structure and trends of energy consumption. Methodical approaches to forecasting energy consumption. The structure of capital investments and operating costs of the fuel and energy complex and its technological systems. Classification of electrical installations as consumers of electricity. Organizational and technical measures to reduce electricity losses.

2.3. Electrotechnical and electromechanical complexes

The efficiency of electricity use and its conversion into other types of energy in the implementation of technological processes. General characteristics of automated process control systems. Electric machines of alternating and direct current. Thyristor and transistor converters. Switching elements and their characteristics. Operating modes of electric drives. Methods and schemes of vector control of asynchronous and synchronous electric drive. Electromechanical converters.

2.4. Energy management and energy efficient technologies

The main directions of energy saving policy and increasing energy efficiency. Modern systems and means of energy and resource saving in electrical installations. Alternative and renewable energy sources. System of technical and organizational measures to increase the level of energy efficiency. Directions and tasks of energy management. Energy audit. Evaluation and monitoring of energy use.

III. EDUCATIONAL AND METHODOLOGICAL MATERIALS

Literature to the 1st section

1. Boyko V.S. Teoretychni osnovy elektrotekhniki: V 3-kh t. Pidruchn. Dlya stud. elektrotekhn. spetsial'n. vyshchykh zakl. osv. Tom 1 / V.S. Boyko, V.V. Boyko, YU.F. Vydolob [ta in.]; za zah. red. I.M. Chyzenka, V.S. Boyka.– K.: IVTS «Politekhnik», 2004. – 272 s.
2. Boyko V.S. Teoretychni osnovy elektrotekhniki: V 3-kh t. Pidruchn. Dlya stud. elektrotekhn. spetsial'n. vyshchykh zakl. osv. Tom 2 / V.S. Boyko, V.V. Boyko, YU.F. Vydolob [ta in.]; za zah. red. I.M. Chyzenka, V.S. Boyka. – K.: IVTS «Politekhnik», 2008. – 224 s.
3. Boyko V.S. Teoretychni osnovy elektrotekhniki: V 3-kh t. Pidruchn. Dlya stud. elektrotekhn. spetsial'n. vyshchykh zakl. osv. Tom 3 / V.S. Boyko, V.V. Boyko, YU.F. Vydolob [ta in.]; za zah. red. I.M. Chyzenka, V.S. Boyka. – K.: IVTS «Politekhnik», 2013. – 244 s.
4. Osnovy teoriiy elektromahnitnoho polya. Kurs lektsiy [Elektronnyy resurs] : navch. posib. dlya stud. spetsial'nosti 141 «Elektroenerhetyka, elektrotekhnik ta elektromekhanika», spetsializatsiyi «Elektromekhanichni systemy avtomatyzatsiyi ta elektropryvod, elektromobil'nist'» / KPI im. Ihorya Sikors'koho, uklad. L. YU. Spinul. – Kyiv : KPI im. Ihorya Sikors'koho, 2020. – 102 s.
5. Proektuvannya elektrychnoyi chastyny elektrychnykh stantsiy ta pidstantsiy: CH. 1 [Elektronnyy resurs] : navchal'nyy posibnyk / NTUU «KPI» ; uklad. YE. I. Bardyk, P. L. Denysyuk, YU. V. Bezberzh'yev. – Kyiv : NTUU «KPI», 2011.
6. Proektuvannya elektrychnoyi chastyny elektrychnykh stantsiy ta pidstantsiy. CH. 2 [Elektronnyy resurs] : navchal'nyy posibnyk / NTUU «KPI» ; uklad. YE. I. Bardyk, P. L. Denysyuk, YU. V. Bezberzh'yev. – Kyiv : NTUU «KPI», 2012.
7. Suleymanov V. M. Elektrychni merezhi ta systemy: pidruchn. / V. M. Suleymanov, T. L. Katsadze. – Kyiv: NTUU «KPI», 2008. – 456 s. 8. Katsadze, T. L. Ekspertni systemy pryynyattya rishen' v enerhetytsi [Elektronnyy resurs] : navchal'nyy posibnyk / T. L. Katsadze ; NTUU «KPI». – Kyiv : LOHOS, 2014. – 175 s.
9. Releynyy zakhyst i avtomatyka: Navch. posibnyk / S. V. Panchenko, V. S. Blyndyuk, V. M. Bazhenov ta in.; za red. V. M. Bazhenova. – Kharkiv: UkrDUZT, 2020. – CH. 1. – 250 s.
10. Releynyy zakhyst i avtomatyka: Navch. posibnyk / S. V. Panchenko, V. S. Blyndyuk, V. M. Bazhenov ta in.; za red. V. M. Bazhenova. – Kharkiv: UkrDUZT, 2021. – CH. 2. – 276 s.
11. Zahirnyak M. V., Nevzlin B.I. Elektrychni mashyny: Pidruchnyk. — 2-he vyd., pererob. i dop. – K.:Znannya, 2009. — 400 s.
12. Elektrychni mashyny : Navch. posib. dlya stud. bazovoho rivnya pidhotovky za napryamkom "Elektromekhanika" / M. A. Yatsun; Derzh. un-t "L'viv. politekhnik". - L., 1999. - 427 c.
13. Netradytsiyni ta vidnovlyuvani dzherela enerhiyi: pidruchn. / S. O. Kudrya. – K. : NTUU «KPI», 2012. – 492 s.

Literature to the 2nd section

1. Prakhovnyk, A. V. Enerhozberezhennya v promyslovosti. Chastyna 1 [Elektronnyy resurs] : navchal'nyy posibnyk / A. V. Prakhovnyk, O. M. Sukhodolya, S. P. Denysyuk [ta in.] ; NTUU «KPI». – Kyyiv : NTUU «KPI», 2011.
2. Enerhozberezhennya v promyslovosti. Chastyna 2: Enerhetychne obladnannya [Elektronnyy resurs] : navchal'nyy posibnyk / A. V. Prakhovnyk, O. M. Sukhodolya, S. P. Denysyuk [ta in.] ; NTUU «KPI». – Kyyiv : NTUU «KPI», 2012.
3. Na shlyakhu do enerhetychnoyi efektyvnosti. Za red. M.P. Kovalko, M.V. Rantsuka, M.M. Kulyka, O.O. Yerokhina. – Kyyiv, Ahent-stvo z ratsional'noho vykorystannya enerhiyi ta ekolohiyi: 1997 p. – 227 s.
4. “Enerhetychnyy menedzhment” / YU.V. Dzyadykevych, M.V. Buryak, R.I. Rozum – Ternopil': Ekonomichna dumka, 2010. – 295 c.
5. Popovych M.H., Lozyns'kyi O.YU., Kleshkov V.B. ta in. Elektromekhanichni systemy avtomatychnoho keruvannya ta elektropryvody. – Kyyiv, “Lybid”, 2005. – 697 s.
6. Tkachuk V.I. Elektromekhanotronika. Pidruchnyk. – L'viv: NU “L'vivs'ka politekhnik” 2006. – 440 s.

IV. RATING SYSTEM FOR EVALUATION OF THE ADDITIONAL ADMISSION TEST

1. The entrant's rating for the exam is calculated based on a 100-point scale.
2. At the exam, entrants prepare for an oral answer to the task of the exam ticket.

Each task of the additional entrance exam contains three theoretical questions. The first two questions are common to the field of electrical engineering. The last question is focused on the preparation of entrants in the specialty 141 "electric Power engineering, Electrotechnics and Electromechanics".

Each of the first two questions is evaluated with 30 points according to the following criteria:

- "excellent", complete answer, not less than 90% of the required information - 27-30 points;
- "good", a sufficiently complete answer, not less than 75% of the required information (minor inaccuracies are allowed) - 23-26 points;
- "satisfactory", incomplete answer, not less than 60% of the required information (the answer contains certain shortcomings) - 18-22 points;
- "unsatisfactory", the answer does not meet the conditions for "satisfactory" - 0 points.

The third question is evaluated with 40 points according to the following criteria:

- "excellent", complete answer, not less than 90% of the required information - 36-40 points;
- "good", a fairly complete answer, at least 75% of the required information (minor inaccuracies are allowed) - 30-35 points;
- "satisfactory", incomplete answer, not less than 60% of the required information (the answer contains certain shortcomings) - 24-29 points;

- "unsatisfactory", the answer does not meet the conditions for "satisfactory" - 0 points.

3. The sum of points for the answers to the exam is transferred to the examination score according to the table:

Points	Rating
100... 95	Perfectly
94... 85	Very good
84... 75	Good
74... 65	Satisfactorily
64... 60	Enough
Less than 60	Unsatisfactorily

IV. EXAMPLE OF EXAMINATION TICKET

Form № H-5.05

**National Technical University of Ukraine
"Igor Sikorsky Kyiv Polytechnic Institute"**

(full name of the higher educational institution)

Educational degree doctor of philosophy

Specialty 141 Electric power engineering, electrotechnics and electromechanics

(name)

Academic discipline Additional entrance examination

PAPER _____

1. Question 1

2. Question 2

3. Question 3

Approved

Guarantor of the educational program _____ Oleksandr YANDULSKY

The program is recommended by:

Academic Council of the Faculty of Electric Power Engineering and Automatics

Chairman of the Academic Council [Signature] Oleksandr YANDULSKY

protocol # 6 from "24" "01" 2022

Academic Council of the Educational and Scientific Institute of Energy Saving and Energy Management

Chairman of the Academic Council [Signature] Sergiy DENYSYUK

protocol # 6 from "24" "01" 2022