

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

Approved by

Head of the Admission Committee



Mykhailo ZGUROVSKY

2.05.2023

Date

PROGRAM
of additional entrance examination

for admission to the educational and scientific program of study for the doctor of philosophy "Electrical Power Engineering, Electrotechnics and Electromechanics"

in specialty 141 Electric Power Engineering, Electrotechnics and Electromechanics

Program is adopted by:

Scientific and methodical commission on specialty
141 Electric Power Engineering, Electrotechnics
and Electromechanics

Protocol No. 4

from «27» 04 2023

Head of the SMC

Olexandr YANDULSKY

Kyiv – 2023

I. GENERAL INFORMATION

An additional entrance examination for the degree of Doctor of Philosophy in 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. Electric power plants, substations and networks, electric power systems.
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 oral 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 Kyiv Polytechnic Institute: <https://aspirantura.kpi.ua/>.

II. TASKS OF THE INTRODUCTORY TEST

1. Electric 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. Electric machines and apparatus

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

1.3. Electric power plants and substations

Ensuring power balance in power systems. The structure of generating capacities of modern electric power systems of Ukraine. Types, technological schemes of power plants of various types and their characteristics. The participation of various power plants in the production of electricity. Load schedules of electrical installations. Adjustment of load schedules. Power quality indicators. Operating

modes of neutrals in electrical installations. General characteristics of the electrical part of power stations.

1.4. Electrical networks and systems

Construction of overhead and cable power transmission lines. Power transformers and autotransformers. Physical processes and phenomena that occur during the transmission of electrical energy along power lines and in power transformers. Voltage drop and voltage loss in electrical network elements. Power losses in electrical networks. Graphs of electrical loads. Concept of power system mode. Classification of modes of electric power systems, requirements for them.

1.5. Control, protection and automation of electric power systems

Balance of active and reactive power. Automatic regulation of frequency and active power Turbine speed regulators. The regulating effect of the load. Primary and secondary frequency regulation. Automatic regulation of voltage and reactive power. Automatic inclusion of the reserve, principles, execution. Automatic reactivation, principles, execution. Protection of electric motors. Protection of transformers. Protection of synchronous generators. Automatic frequency unloading (AFU). Relay protection of buses of stations and substations.

1.6. Alternative and renewable energy sources

Types of wind turbines and wind generators. Their advantages and disadvantages. Basic designs of solar collectors and photobatteries. Energy storage systems of renewable sources. Advantages of integrated use of renewable energy sources and energy storage systems. Application of bioenergy installations for the production of energy and new types of biofuels. Classification of energy accumulators and the specifics of their application. Basic technologies for the production of semiconductor photocells. The specifics of the application of solar collectors in the conditions of Ukraine.

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 systems of providing consumers with electric energy. Structure of power supply systems. Requirements for reliability of power supply. Requirements for the quality of electrical energy. Estimated load in power supply systems. Methods of calculating losses of electrical energy in electrical networks. Reactive power. Examples and characteristics of the main consumers of reactive power. Losses are associated with the transfer of reactive power. Protection in power supply systems, requirements for relay protection. Classification of electrical devices, requirements and basic parameters of electrical devices. The structure and elements of a modern electric drive. Classification of a simple electric drive. Operating modes of electric motors and their electromechanical characteristics. Replacement schemes of an asynchronous motor and equations of its electromechanical characteristics.

2.2. Energy complexes and systems

Analysis of the main fuel and energy losses. Structure and trends of energy consumption. Classification of electrotechnological installations as consumers of electricity. Organizational and technical measures to reduce electrical energy losses.

2.3. Electrotechnical and electromechanical complexes

The efficiency of the use of electrical energy and its transformation into other types of energy during the implementation of technological processes. General characteristics of automated control systems for technological processes. Alternating current and direct current electric machines. Thyristor and transistor converters. Monitoring and diagnostics of electrical engineering complexes.

2.4. Energy management and energy-efficient technologies

The main directions of the policy of energy saving and increasing the level of energy efficiency. Modern systems and means of energy and resource saving in electrotechnological installations. Alternative and renewable energy sources. A system of technical and organizational measures to increase the level of energy efficiency. Directions and tasks of energy management. Assessment and monitoring of energy use.

2.5. Theory of electric and magnetic circuits

Linear electric circuits of direct current (basic laws of electrical engineering). Three-phase and single-phase linear electric circuits of alternating current. Nonlinear direct current circuits. General characteristics of direct current and alternating current magnetic circuits.

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. Chyzhenka, 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. Chyzhenka, 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. Chyzhenka, 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. – Kyyiv : NTUU «KPI», 2012.

7. Kyryk V.V. Elektrychni merezhi ta systemy. Rezhymy roboty rozimknenykh merezh. = Electrical power networks and systems. Operation modes of open networks: navch. posib. / V. V. Kyryk, T.B. Maslova. – Kyyiv: NTUU «KPI», 2015. – 256 s.

8. Kyryk V. V. Elektrychni merezhi ta systemy : pidruchnyk / V. V. Kyryk. – Kyyiv : KPI im. Ihorya Sikors'koho, Vyd-vo «Politekhnik», 2021. – 324 s.– ISBN 978-966-990-031-9

9. Katsadze T. L. Elektrychni systemy i merezhi. Rozrakhunok ta analiz ustalenykh rezhymiv elektroenerhetychnykh system: Navchal'nyy posibnyk / T. L. Katsadze, V. V. Kyryk.-K.: KPI im. Ihorya Sikors'koho, 2018.-212 s

10. Elektrychni systemy i merezhi. Chastyna 1 [Elektronnyy resurs] : navchal'nyy posibnyk / YU. V. Malohulko, O. B. Burykin, T. L. Katsadze, V. V. Netrebs'kyy ; Vinnyts'kyy natsional'nyy tekhnichnyy universytet ; za red. P. D. Lezhnyuka. – Vinnytsya : VNTU, 2020. – 200 s.

11. Yandul's'kyy O.S., Stelyuk A.O., Lukash M.P. Avtomatychne rehulyuvannya chastoty ta peretokiv aktyvnoyi potuzhnosti v enerhosystemakh / Pid zahal'noyu redaktsiyeyu O.S. Yandul's'koho. – K.: NTUU «KPI», 2010. – 88 s.

12. Releynnyy 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.

13. Releynnyy 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.

14. Zahirnyak M. V., Nevzlin B.I. Elektrychni mashyny: Pidruchnyk. — 2nd vyd., pererob. i dop. – K.:Znannya, 2009. — 400 s.

15. 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.

16. Enerhoefektyvni elektromekhanichni systemy shyrokooho tekhnolohichnoho pryznachennya. Monohrafiya / Zahirnyak M. V., Klepikov V. B., Kovbasa S. M., Mykhal's'kyy V. M., Peresada S. M., Sadovoy O. V., Shapoval I. A. - Kyyiv, Instytut elektrodynamiky NAN Ukrainy, 2018. - 310 s.

17. Netradytsiyni ta vidnovlyuvani dzherela enerhiyi: pidruchn. / S. O. Kudrya. – K. : NTUU «KPI», 2012. – 492 s.

18. Vidnovlyuvani dzherela enerhiyi [Elektronnyy resurs] : monohrafiya / Barylo A. A., Benmenni M., Bud'ko M. O. ta in. ; IVE NANU / [Za zah. red. S. O. Kudri]. – Elektronni tekstovi danni (1 fayl: 11.14 Mbayt). – Kyyiv : Instytut vidnovlyuvanoyi enerhetyky NANU, 2020. – 392 s.

19. Kuznyetsov, M. P. Osoblyvosti kombinovanykh enerhosystem z vidnovlyuvanymy dzherelamy enerhiyi [Elektronnyy resurs] : monohrafiya / M. P. Kuznyetsov ; IVE NANU. – Elektronni tekstovi danni (1 fayl: 4,96 Mbayt). – Kyyiv : IVE, 2022. – 152 s.

20. Atlas enerhetychnoho potentsialu vidnovlyuvanykh dzherel enerhiyi Ukrainy (vydannya druhe, onovlene ta dopovnene) / S. O. Kudrya, V. F. Ryeztsov, T. V. Surzhyk ta inshi. – Kyiv: Instytut vidnovlyuvanoyi enerhetyky NAN Ukrainy, 2020. – 82 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». – Kyiv : 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». – Kyiv : NTUU «KPI», 2012.

3. Na shlyakhu do enerhetychnoyi efektyvnosti. Za red. M.P. Kovalko, M.V. Rantsuka, M.M. Kulyka, O.O. Yerokhina. – Kyiv, 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'kyy O.YU., Kleshkov V.B. ta in. Elektromekhanichni systemy avtomatychnoho keruvannya ta elektroprivody. – Kyiv, “Lybid”, 2005. – 697 s.

6. Tkachuk V.I. Elektromekhanotronika. Pidruchnyk. – L'viv: NU “L'vivs'ka politekhnika” 2006. – 440 s.

7. 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. Chyzhenka, V.S. Boyka.– K.: IVTS «Politekhnika», 2004. – 272 s.

8. 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. Chyzhenka, V.S. Boyka. – K.: IVTS «Politekhnika», 2008. – 224 s.

9. 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. Chyzhenka, V.S. Boyka. – K.: IVTS «Politekhnika», 2013. – 244 s.

10. Sinchuk O.M. Tekhnichna diahnozyka elektrotekhnichnykh system: MonohrafiyaKremenichuk: Vyd. PP Shcherbatykh O.V., 2012- 264s.

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:

- complete answer, not less than 90% of the required information - 27-30 points;
- sufficiently complete answer, not less than 75% of the required information (minor inaccuracies are allowed) - 23-26 points;
- incomplete answer, not less than 60% of the required information (the answer contains certain shortcomings) - 18-22 points;
- answer is missing or completely incorrect - 0 points.

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

- complete answer, not less than 90% of the required information - 36-40 points;
- sufficiently complete answer, not less than 75% of the required information (minor inaccuracies are allowed) - 30-35 points;
- incomplete answer, not less than 60% of the required information (the answer contains certain shortcomings) - 24-29 points;
- answer is missing or completely incorrect - 0 points.

3. The sum of points for the answers to the examination converted to the examination score according to the table:

Points	Rating
95...100	Passed
85...94	
75...84	
65...74	
60...64	
Less than 60	Failed

IV. EXAMPLE OF EXAMINATION TICKET

**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

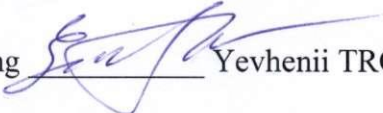
3. Question 3

Approved

Guarantor of the educational program _____ Oleksandr YANDULSKY

The translation of the program of additional entrance examination into English performed by:

Associate Professor of

the Department of Theoretical Electrical Engineering  Yevhenii TROTSENKO


The program of the additional entrance examination for admission to the educational-scientific program of study for the doctor of philosophy in "Electric Power Engineering, Electrotechnics and Electromechanics" in the specialty 141 "Electric Power Engineering, Electrotechnics and Electromechanics" is recommended by:

Academic Council of the Faculty of Electric Power Engineering and Automatics

Chairman of the Academic Council  Oleksandr YANDULSKY

protocol # 10 from "24" 04 2023

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

Chairman of the Academic Council  Serhii DENYSIUK

protocol # 9 from "26" 04 2023