

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



Approved by

Head of the Admission Committee
Rector

Signature

Anatolii MELNYCHENKO

04.05.2026

Date

PROGRAMME
of additional entrance examination

for admission to the educational and scientific program of study for the Doctor of
Philosophy "Electric Power Engineering, Electrotechnics and Electromechanics"

in specialty G3 Electrical Engineering

Programme is adopted by:

Scientific and methodical commission on
specialty G3 Electrical Engineering

Protocol No. 5(9)

from «1 st» May 2026

Head of the SMC

Serhii BURIAN

INTRODUCTION

The programme defines the form of organisation, content and peculiarities of conducting an additional entrance examination for the Doctor of Philosophy degree programme “Electric Power Engineering, Electrotechnics and Electromechanics” in the speciality G3 Electrical Engineering for applicants who apply for a Doctor of Philosophy degree in another field of knowledge (speciality).

The purpose of the programme is to test the applicant's acquisition of the competencies and learning outcomes required to master the educational and scientific programme for the preparation of Doctor of Philosophy in Electric Power Engineering, Electrotechnics and Electromechanics of speciality G3 Electrical Engineering.

1. MAIN SUMMARY

1.1. List of sections and topics to be included in the additional entrance examination

Section 1. Electric power plants, substations and networks, electric power systems

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.

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.

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.

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.

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.

6. Electromechanical automation systems and electric drive

General information about the electrical drives. Types of electrical drives. Functional diagram of the electrical drive. Mechanical part of the electrical drive. Kinematic and calculation diagrams. Static loads. Equation of motion of the electrical drive. Basic characteristics and principle of operation of DC motors, induction and synchronous motors, their advantages and disadvantages. Power electronics devices in electromechanical systems. Automatic control systems, functional diagram of the automatic control system and its elements. General concepts of open and closed automatic control systems. Stabilization systems, program control, tracking control.

Section 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.

1.2. The procedure for conducting an additional entrance examination

The additional entrance examination is conducted in the form of a written paper. There are 50 examination tickets for the test, each of which contains three theoretical questions from the first or second sections.

At the beginning of the exam, the members of the certification committee inform applicants about the procedure for conducting an additional entrance examination, the specifics of the paper layout, and give applicants exam papers with the appropriate options and pre-printed signed sheets for writing papers. Subsequently, applicants write down written answers to the questions on the examination paper on these sheets, indicate the date and put their personal signature at the end of the paper.

The total time of the additional entrance examination is 105 minutes and is distributed as follows:

- for the organizational part of the professional exam (explanations on the conduct, design and evaluation criteria of the exam, issuance of tickets and sheets for writing the paper) –10 minutes;

- for handwritten completion of the exam paper tasks – 90 minutes;
- for the final part (collection of tickets and written papers from applicants by members of the certification commission) – 5 minutes.

The start time and end time of the exam are announced by the members of the Attestation Board.

After the completion of the additional entrance examination, the answers are checked and evaluated by all members of the commission. The members of the Attestation Commission make a joint decision on assigning a grade to each of the questions on the examination paper. These marks are given on the student's answer sheet.

The results of the additional entrance examination are summed up by entering the scores in the examination record. The student's acquaintance with the results of the additional entrance examination is carried out in accordance with the rules of admission to the University.

1.3. Auxiliary materials

The use of supplementary literature and other aids is prohibited during the additional entrance examination.

1.4. Rating system of assessment (RSA)

In a written answer to the theoretical questions of the additional entrance examination, the applicant must demonstrate knowledge of the theory of the discipline, conceptual and categorical apparatus, terminology, and principles of the subject area of the discipline. The applicant must present answers clearly, logically and consistently.

In answering the theoretical tasks of the examination paper, the following are evaluated:

- completeness of disclosure of the question;
- ability to clearly formulate definitions of concepts/terms and explain them;
- the ability to argue the answer;
- analytical reasoning, comparison, formulation of conclusions;
- accuracy of the written work.

The maximum score that can be obtained for answering the first and second questions of the examination paper is 30. Answers to the first and second questions of the examination paper are assessed according to the following criteria

- complete answer, at least 90% of the required information – 27-30 points;
- a sufficiently complete answer, at least 75% of the required information (minor inaccuracies are permissible) – 23-26 points;
- incomplete answer, not less than 60% of the required information (the answer contains certain shortcomings) – 18-22 points;
- no answer or completely incorrect answer – 0 points.

The maximum score that can be obtained for answering the third question of the examination paper is 40. Answers to the first and second questions of the examination paper are assessed according to the following criteria

- complete answer, at least 90% of the required information – 36-40 points;
- a sufficiently complete answer, at least 75% of the required information (minor inaccuracies are permissible) – 30-35 points;
- incomplete answer, not less than 60% of the required information (the answer contains certain shortcomings) – 24-29 points;
- no answer or completely incorrect answer – 0 points.

The total score of an applicant for an additional entrance examination is determined as the sum of the points received by the applicant for answering each question of the examination paper. The maximum score that can be obtained based on the results of an additional entrance test is 100.

Applicants whose results of the additional entrance examination on the RSE scale range from 60 to 100 points receive a grade of ‘pass’ and are allowed to take the entrance examination in the speciality.

Applicants whose results of the additional entrance examination on the RSE scale range from 0 to 59 points receive a grade of ‘not pass’ and are not allowed to participate in subsequent entrance examinations and in the competitive selection.

1.5. Example of a typical examination paper for the additional entrance examination

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Educational degree	Doctor of Philosophy
Speciality	G3 Electrical Engineering
Educational programme	Electric Power Engineering, Electrotechnics and Electromechanics
Examination	Additional entrance examination

EXAMINATION PAPER № 1

1. Features of nonlinear alternating current circuits and methods of their calculation.
2. Three-phase and single-phase linear electric circuits of alternating current.
3. Automatic reactivation, principles, execution.

Adopted by University scientific and methodical commission
protocol No. ___ from «___» _____ 2026

Guarantor of the educational programme

Serhii KOVBASA

2. FINAL PROVISIONS

1. Persons who did not appear at the entrance examinations at the time specified in the schedule without valid reasons and persons whose knowledge was assessed with scores below the established level are not allowed to participate in subsequent entrance examinations and in the competitive selection.

2. Retakes of entrance examinations are not allowed.

LIST OF RECOMMENDED REFERENCES

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