**MINISTRY OF EDUCATION AND SCIENCE OF UKRAINE**
**Electric Power Engineering, Electrical Engineering and Electromechanics**

**NATIONAL TECHNICAL UNIVERSITY**
**«KHARKIV POLYTECHNIC INSTITUTE»**

**APPROVED BY**
Rector of NTU "KhPI"
_____Ye.Sokol
«____»_____20___.

# EDUCATIONALLY - PROFESSIONAL PROGRAM

# «ELECTRIC POWER ENGINEERING»

**The Second (Master) Level**

by specialty **141 «Electric Power Engineering, Electrical Engineering and Electromechanics»**
Knowledge field title **14 «Electrical engineering»**
Qualification: **Bachelor of Electric Power Engineering, Electrical Engineering and Electromechanics**

**APPROVED BY**
**Academic Council of NTU "KhPI"**

Chairman of the Scientific Council

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Protocol № _____
«___» _____ 20___.

Kharkiv 2019

# INTRODUCTION

**Developed by the working group on specialty 141 "Electric Power Engineering, Electrical Engineering and Electromechanics" on the basis of the draft higher education standard developed by the scientific-methodical subcommittee of the Ministry of Education and Science of Ukraine**.

Members of the working group:

- Shevchenko Sergiy Yuryevich, Doctor of Technical Sciences, Professor, Head of the Department of Transmission of Electric Energy,
- Gleb Oleg Gerasimovich, Doctor of Technical Sciences, Professor, Head of the Department of Automation and Cybersecurity of Power Systems,
- Gurin Anatoly Grigorievich, Doctor of Technical Sciences, Professor, Head of the Department of Electrical Insulation and Cable Engineering,
- Rezinkin Oleg Lukyanovich, Doctor of Technical Sciences, Professor, Head of the Department of Engineering Electrophysics,
- Omelyanenko Galina Viktorovna, Candidate of Technical Sciences, Professor of the Department of Transmission of Electric Energy.

Head of the security group of specialty 141 “Electric Power Engineering, Electrical Engineering and Electromechanics “:

Lazurenko Alexander Pavlovich, Ph.D., Professor,
Head of the Department of Electric Power Stations _____

**APPROVAL PAGE**

educationally - professional program «ENERGETICS»

| | |
|---|---|
| **Higher education level** | **The Second (Master ) Level** |
| **Knowledge field title** | **14 Electrical engineering** |
| **Specialty** | **141 « Electric Power Engineering, Electrical Engineering and Electromechanics »** |
| **Specializations** | **141-01 "Electric Power Stations"**<br>**141-02 «Electrical systems and networks»**<br>**141-03 "Electricity Production and Distribution Management Systems"**<br>**141-04 «Electrical Insulation, Cable and fiber optic technique»**<br>**141-05 "Energy Management and Energy Efficient Technologies"**<br>**141-12 "Renewable energy sources, technique and high-voltage electrical physics"**<br>**141-15 «Cybersecurity technologies in electric power industry»** |
| **Qualification** | **Master of Electric Power Engineering, Electrical Engineering and Electromechanics** |

**APPROVED**
Chairman of the support group
for the specialty

Head _____ O.P. Lazurenko
«____»_____20___.

**RECOMMENDED**
Methodical Council of NTU "KhPI"

_____ R.P. Mygushchenko
«____»_____20___.

**APPROVED AND PROVIDED**

By order of the rector of the National Technical University "Kharkiv Polytechnic Institute" from «__»_____20 ___ . № _____

CONTENT

## 1. Profile of the educational program «Energetics» by specialty 141 «Electric Power Engineering, Electrical Engineering and Electromechanics»

| 1 – General information | |
|---|---|
| Full name of higher educational institution and structural unit | National Technical University "Kharkiv Polytechnic Institute"<br>Institute of Education and Science in Power Engineering, Electronics and Electromechanics<br>Departments: electric power stations, transmission of electric energy, automation and cyber security of power systems, electrical insulation and cable engineering, engineering electrophysics |
| The degree of Higher education and the name of the qualification in the original language title | Master's degree in higher education<br>Educational qualification - a master of Electric Power Engineering, Electrical Engineering and Electromechanics<br>Diploma qualification is an electrical engineer |
| The official name of the educational program | educationally - professional program of The Second (Master) Level of the «Energetics» higher educational level. |
| Type of diploma and volume of educational program | Bachelor's degree, unitary, 90 ECTS credits,<br>term of training 1 year 4 month |
| Availability of accreditation | - Certificate of Accreditation: НД-IV №2158893:<br>- Ministry of education and science of Ukraine;<br>- Validity: until July 1, 2023 |
| Cycle / Level | FQ-EHEA – second cycle, EQF LLL – 7 level, NQF Ukraine – 8 level (Master's degree) |
| Prerequisites | Complete general secondary education or secondary specialized education<br>By results of external testing<br>The remaining requirements are determined by the rules of admission to the educational and professional program of the bachelor. |
| Language (s) of teaching | Ukrainian, Russian, English |
| The validity of the educational program | According to the validity period of the certificate of accreditation |
| Internet address of the educational program | http://www.kpi.kharkov.ua/ukr/<br>http://www.kpi.kharkov.ua/rus/faculty/e/ |
| **2 – The purpose of the educational program** | |
| The combination of theoretical knowledge, practical skills, skills and competences sufficient for the successful performance of professional duties in specialty 141 "Electric Power Engineering, Electrical Engineering and Electromechanics" and prepare students for further employment in the chosen specialty in the subject area "Electrical engineering", mastering of the programs of the following levels (Doctor of Philosophy) for researchers<br>The achievement of the stated goal is based on the principles of continuity and individualization of learning, the fundamental and integral provision of knowledge, practical orientation and awareness of the place of the received competencies, symbiosis of scientific and systemic approaches, etc. | |

| 3 - Characteristics of the educational program | |
|---|---|
| **Subject area (area of knowledge, specialty, specialization)** | Knowledge field title: 14 «Electrical engineering»<br>Specialty title: 141 « Electric Power Engineering, Electrical Engineering and Electromechanics »<br>Specializations:<br>Block 01 "Electric Power Stations"<br>Block 02 «Electrical systems and networks»<br>Block 03 "Electricity Production and Distribution Management Systems"<br>Block 04 «Electrical Insulation, Cable and fiber optic technique»<br>Block 05 "Energy Management and Energy Efficiency Technologies"<br>Block 13 "Renewable energy sources"<br>Block 14 " Technique and Electrophysics of High Voltages"<br>Block 15 "Cybersecurity Technologies in Power Engineering" |
| **Orientation of the educational program** | The educational and professional master's program has an applied orientation, focuses on topical specialization, within which further professional and scientific careers are possible: electric power stations, energy management and energy efficient technologies, electric systems and networks, production and distribution management systems , electrical insulation, cable and opto-fiber technology, renewable energy sources, technology and high-voltage electrophysics, cybersecurity technologies in electro-power engineering |
| **The main focus of the educational program and specialization** | General, specialized education and training in the field of electric power engineering, electrical engineering and electromechanics with the possibility of acquiring the necessary practical (engineering) and research skills for a professional in the field and scientific careers.<br>***Key words:*** electrical and electrical systems, complexes, devices and equipment, electric stations, systems and networks, systems of relay protection and control, energy efficiency and energy saving, electrical insulating and cable engineering, cybersecurity .. |
| **Features of the program** | The main aspect of the program is the orientation towards professional engineer-ing activities. During the period of study in a magistracy student must take part in a scientific conference and have scientific publications |
| **4 - Eligibility of graduates to employment and further training** | |
| **Suitability for work placement** | Jobs in research centers and companies of electric power, electrical engineering and electrical engineering, enterprises and electrical industry.<br>Types of economic activity according to DK003: 2010 codes of KP from 2143.1 to 2144.1 |
| **Further training** | Graduates have the right to continue their education at the third (higher education) education level (FQ-EHEA), EQF-8 level 8, and the 8th level of the NQF Ukraine on a competitive basis, and to continue studying abroad to obtain a doctorate in philosopher's degree. |
| **5 - Teaching and evaluation** | |
| **5 - Teaching and evaluation** | Lectures, practical and laboratory lessons, computer practical skills; individual lessons, consultations, master's degree work.<br>The use of mixed learning technologies: information and communication, student-centered, modular, technology research training, collaborative learning technologies, and pro-active education |

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| | techniques. |
| **Evaluation** | Evaluation of students' educational achievements is carried out according to the ECTS system (with grades A, B, C, D, E, F), the national system (with grades “excellent”, “good”, “satisfactory” and “unsatisfactory”), as well as 100 point system of universities with an established system of compliance. |

| **6 - Program competencies** | |
|---|---|
| **Integral competence** | Ability to solve complex specialized tasks and solve practical problems, including innovative character, during professional activity in the field of electric power engineering, electrical engineering and electromechanics, or in the process of training involving the application of theories and methods of electrical engineering and electromechanics and is characterized by complexity and uncertainty of the conditions. |
| **General competency (GC)** | **GC** 1. Ability to think, analyze and synthesize.<br>**GC** 2. Ability to search, process and analyze information from different sources.<br>**GC** 3. Ability to use information and communication technologies.<br>**GC** 4. Ability to apply knowledge in practical situations.<br>**GC** 5. Ability to use a foreign language for carrying out scientific and technical activities.<br>**GC** 6. Ability to make informed decisions.<br>**GC** 7. Ability to learn and master modern knowledge.<br>**GC** 8. Ability to detect and assess risks.<br>**GC** 9. Ability to produce new ideas, show creativity, ability to think systematically.<br>**GC** 10. Ability to work independently and in a team, the ability to communicate with colleagues in the field of research and development.<br>**GC** 11. Ability to detect feedback and adjust their actions with their consideration.<br>**GC** 12. Ability to assess and maintain the quality of work performed.<br>**GC** 13. Ability to demonstrate awareness of intellectual property issues in the field of electronics and telecommunications. |
| **Professional competence of the specialty (PC)** | **PC 1.** Ability to apply the obtained theoretical knowledge, scientific and technical methods and corresponding software for the decision of scientific and technical problems and carry out scientific researches in the field of electroenergy, electrical engineering and electromechanics.<br>**PC 2.** Ability to apply existing and develop new methods, techniques, technologies and procedures for solving engineering tasks, including at the design and operation of power engineering, electrical engineering and electromechanics.<br>**PC 3.** Ability to apply analytical methods of analysis, mathematical modeling and perform physical, mathematical and computational experiments for the solution of engineering tasks and in conducting research.<br>**PC 4.** Ability to apply information and communication technologies and programming skills to solve typical tasks of engineering activities in power engineering, electrical engineering and electromechanics.<br>**PC 5.** Ability to understand and take into account social, environmental, ethical, economic and commercial considerations that influence the implementation of technical solutions in power |

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| | engineering, electrical engineering and electromechanics.<br>**PC 6.** Ability to manage projects and critically evaluate their results.<br>**PC 7.** Knowledge and understanding of the laws, mechanisms and consequences of equipment failures, the ability to develop and implement measures to improve the reliability, efficiency and safety of designing and operating equipment and facilities of electric power, electrical engineering and electromechanics.<br>**PC 8.** Knowledge and understanding of modern technological processes and systems of technological preparation of production, technical characteristics, design features, purpose and rules of operation of electric power, electrical and electromechanical equipment and equipment.<br>**PC 9.** Ability to use the acquired knowledge and skills for work in the subject field and understand the necessity of observance of safety rules during performance of official duties in power engineering, electrical engineering and electromechanics.<br>**PC 10.** Ability to demonstrate understanding of normative legal acts, norms, rules and standards in electric power engineering, electrical engineering and electromechanics<br>**PC 11.** Ability to use the acquired knowledge and skills for carrying out scientific research of the corresponding level.<br>**PC 12.** The ability to prepare and publish the results of their research in scientific journals.<br>**PC 13.** Ability to collect and analyze the necessary data concerning the characteristics of electric power stations, main electrical equipment for their own needs, as well as trends in their development, in particular, using modern information and computer technologies.<br>**PC 14.** The ability to select methods and make appropriate calculations for analyzing the operating modes of electrical systems and networks and modes in the elements of circuits and processes in systems and networks.<br>**PC 15.** Ability to carry out design, operational and research work on the means of relay protection, system and accident prevention automation in the electric power system.<br>**PC 16.** The ability to analyze electromagnetic and thermophysical processes for determining the optimal operating conditions depending on the load conditions of high-voltage electrical insulation and cable systems.<br>**PC 17.** Ability to organize a system of energy management at enterprises and institutions, conduct energy surveys, develop and implement measures to improve energy efficiency in industry and everyday life, and assess their contribution to reducing harmful emissions.<br>**PC 18.** Ability to collect and analyze technical data on the current state of the prospects for the development of energy sources and, on this basis, develop measures to increase the energy efficiency of facilities.<br>**PC 19.** Ability to perform physical and mathematical modeling of processes in high-voltage electrophysical installations.<br>**PC 20.** Ability to carry out design, operational and research work on the information security of relay protection and automation equipment in the electric power system. |

| 7 - Program learning outcomes | |
|---|---|
| | **PLO** 1. To recreate processes in electric power, electrotechnical and electromechanical systems during their simulation on a personal computer.<br>**PLO** 2. To analyze processes in electric power, electro-technical and electromechanical equipment and corresponding complexes and systems.<br>**PLO** 3. Find options for increasing the energy efficiency of electric energy, electrotechnical and electromechanical equipment and related complexes and systems.<br>**PLO** 4. Determine the plan of measures for increasing the reliability, safety of operation and continuation of the resource of electric power, electrotechnical and electromechanical equipment and corresponding complexes and systems.<br>**PLO** 5. Develop and implement systemic measures to increase the reliability, efficiency of operation and continuation of the resource of equipment and facilities of electric power industry, electrical engineering and electromechanics.<br>**PLO** 6. To possess methods of mathematical and physical modeling of objects and processes in electric power and electromechanical systems.<br>**PLO** 7. Controlling new versions or new software designed for computer simulation of objects and processes in electric power, electrical and electromechanical systems.<br>**PLO** 8. Estimate the total cost of research and development.<br>**PLO** 9. Protecting your intellectual property rights and respecting similar rights of others, applying a system of legal protection and intellectual property rights.<br>**PLO** 10. Find information on resources to find educational programs, grants and scholarships of the European Union and Member States of the European Union.<br>**PLO** 11. To choose the direction of scientific research and take part in it taking into account the current problems in the field of electrical energy, electrical engineering and electromechanics.<br>**PLO** 12. Participate in international scientific conferences and seminars devoted to modern problems in the field of electromechanics, electrical engineering and electromechanics.<br>**PLO** 13. To solve professional tasks in design, installation and operation of electric, electrical, electromechanical complexes and systems.<br>**PLO** 14. To control new methods of synthesis of electric power, electrotechnical and electromechanical installations and systems with given parameters<br>**PLO** 15. Combine the methods of empirical and theoretical research to find ways to reduce the loss of electric energy in its production, transportation, distribution and use.<br>**PLO** 16. Ability to apply pedagogical and psychological techniques in professional and managerial activity.<br>**PLO** 17. To know the methods of organization, technology and processes of electric power generation based on traditional and renewable energy sources, and energy storage for maneuvering and maintaining the balance in power systems.<br>**PLO** 18. Know the principles of organization of processes of transportation and distribution of electricity and power in electric |

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| | systems and networks from generation to consumer.<br>**PLO** 19. Know the principles of organization of the processes of management of production and distribution of electricity in electric power systems and systems of consumer power supply.<br>**PLO** 20. Know and be able to predict the behavior of modern high-volatile electrical insulation structures and systems taking into account the influence of external factors and operating modes at the stage of design and modernization of electrical equipment.<br>**PLO** 21. To analyze the current state and identify trends in the development of technologies and methods of energy saving, increase energy efficiency and use of renewable energy sources, in particular market mechanisms for stimulating energy efficiency.<br>**PLO** 22. To be able to effectively apply modern methods for determining the conditions and parameters of the operation of non-conventional and renewable energy systems.<br>**PLO** 23. To be able to use modern scientific knowledge and apply effectively in the field of functioning of high-voltage installations.<br>**PLO** 24. To be able to use and introduce knowledge on the information security of automation and anti-aircraft control systems to ensure the stability of the electric power system.<br>**PLO** 25. To possess modern methods of mathematical and physical modeling of objects and processes, planning of experiment, processing of its results and efficient use of results in researches in the field of electroenergetics. |

| **8 - Resource support for the implementation of the program** | |
|---|---|
| **Personnel support** | All the scientific and pedagogical staff providing the educational-professional program in accordance with the qualification correspond to the profile and the direction of the disciplines being taught, have the necessary experience of teaching work and experience of practical work. In the process of organization of the educational process, professionals are attracted from the research / management / innovation / creative work and / or work in the specialty. 100% of teachers providing English language education are certified according to the European language guidance guidelines (level B2) or qualifications relating to the use of a foreign language. |
| **Material and technical support** | Material and technical support allows you to fully ensure the educational process throughout the training cycle for the educational program. The condition of the premises is certified by sanitary and technical passports, which correspond to the existing normative acts. |
| **Information and educational and methodological support** | Information support is provided by textbooks, educational aids, etc. and electronic resources (the library is provided with at least five titles of domestic and foreign professional periodical professional publications of the corresponding or related profile, including in electronic form). Methodical support is realized by the obligatory accompaniment of educational activity with the corresponding educational and methodological materials for each educational discipline of the educational plan. |
| **9 - Academic mobility** | |
| **National Credit Mobility** | "Kharkiv Polytechnic Institute" and higher educational institutions On the basis of bilateral agreements between the National Technical University of Ukraine |
| **International Credit Mobility** | On the basis of bilateral agreements between the National Technical University of "KhPI" and the educational institutions of the partner |

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| | countries. |
| **Teaching foreign applicants for higher education** | According to the license of NTU "KhPI" foreigners and / or stateless persons can study for the educational program. Curricula for this contingent have expanded language training in the Ukrainian language.<br>In order to create conditions for international academic mobility, a higher education institution has the right to decide on the presentation of one / several / all disciplines in English and / or other foreign languages, while ensuring the knowledge of higher education students of the relevant discipline in the state language.<br>For the teaching of academic disciplines in foreign (English), separate groups are formed for foreign citizens, stateless persons who wish to obtain higher education for the funds of individuals or legal entities, or develop individual programs. At the same time, programs of higher education institutions provide for the study of such persons of the state language as a separate educational discipline. |

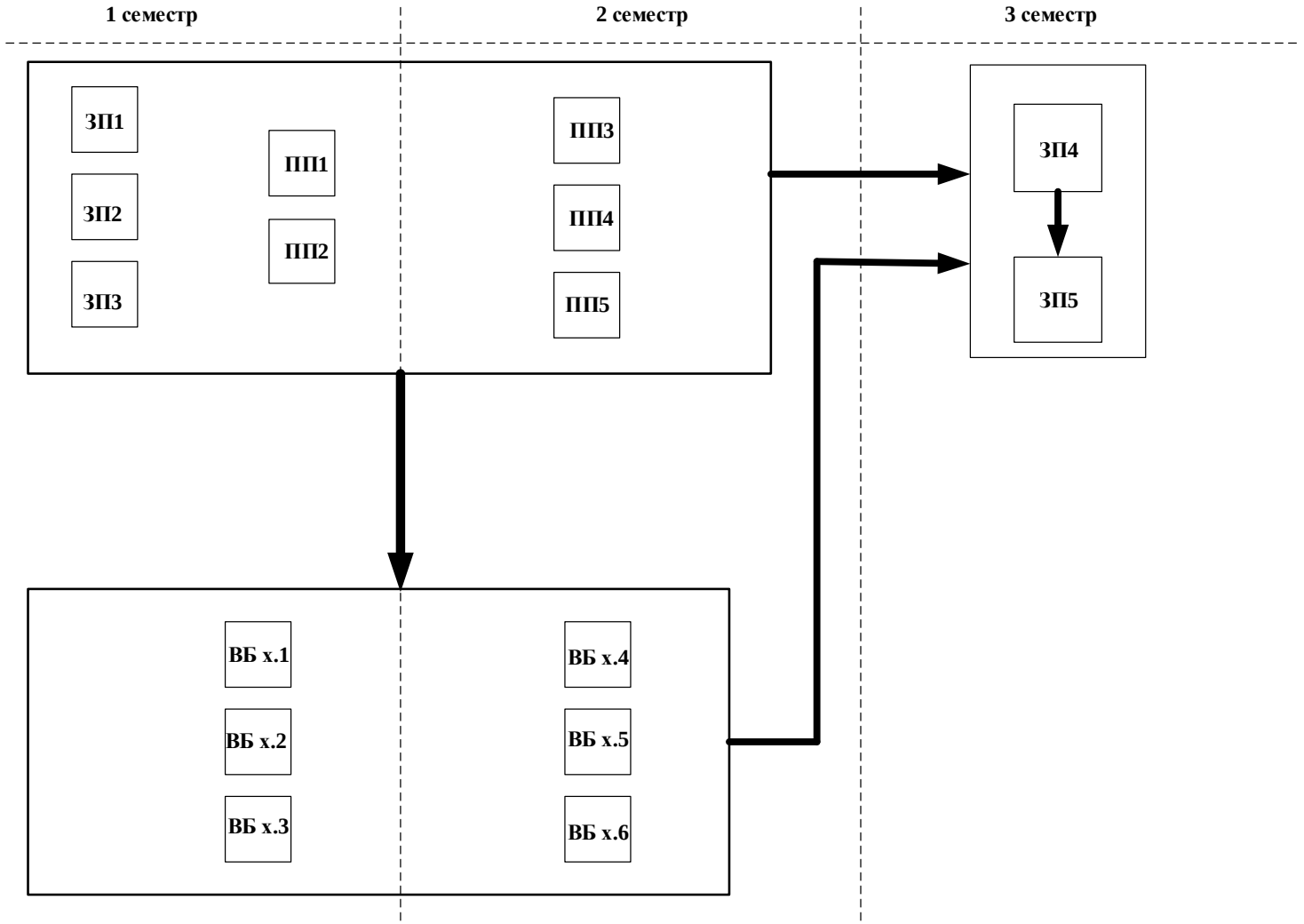
## 2. List of components of educational-professional program "Electric Power Engineering" and their logical consistency

### 2.1. List of components of EPP

| Key | Components of the educational program (educational disciplines, course projects (works), practical work, qualification work) | Amount of credits | Form final control |
|---|---|---|---|
| 1 | 2 | 3 | 4 |
| **Compulsory components of educationally- professional program** | | | |
| GT 1 | Organization of production and marketing | 3 | Test |
| GT 2 | Safety of work and professional activity | 3 | Test |
| GT 3 | Intellectual Property | 3 | Test |
| PT 1 | Basics of the scientific research | 3,0 | Test |
| PT 2 | Simulation of electrical and electromechanical systems and devices | 5,0 | Exam |
| PT 3 | Technologies, problems and prospects of the industry | 4,0 | Exam |
| PT 4 | Reliability and diagnostics | 5,0 | Exam |
| PT 5 | Design of electric and electromechanical systems and devices | 6,0 | Exam |
| GT 4 | Pre-diploma practice | 11 | Test |
| GT 5 | Attestation (diploma project) | 19 | Test |
| **Total volume of Required components** | | **62** | |
| **Selective components of EPP** | | | |
| **Discipline block 01 "Electric Power Stations"** | | | |
| SC 1.1. | Technologies of accumulation and maneuvering in power systems | 4,0 | Exam |
| SC 1.2. | Systems of own needs of electric power stations | 5,0 | Exam |
| SC 1.3. | Dispatcher control and control systems of electric power stations | 4,0 | Exam |
| SC 1.4. | Optimization tasks of power engineering | 6,0 | Exam |
| SC 1.5. | Energy management | 4,0 | Test |
| SC 1.6. | Environmental aspects of energy | 5,0 | Exam |
| | **Total:** | **28** | |
| **Discipline block 02 " Electrical systems and networks "** | | | |
| SC 2.1. | Organization of energy consumption | 4,0 | Exam |
| SC 2.2. | Manage power systems | 4,0 | Exam |
| SC 2.3. | Mathematical foundations of technical diagnostics | 5,0 | Exam |
| SC 2.4. | Fundamentals of Energy Security | 5,0 | Exam |
| SC 2.5. | Dispatch control and information and control systems | 5,0 | Test |
| SC 2.6. | Basics of operation of objects of electric systems and networks | 5,0 | Exam |
| | **Total:** | **28** | |
| **Discipline block 03 " Systems of control of production and distribution of electric power "** | | | |
| SC 3.1. | Modern technologies and methods of building relay protection and automation systems | 4,0 | Exam |
| SC 3.2. | Automation of power systems Part 1 | 5,0 | Exam |
| SC 3.3. | Information transmission in power industry | 4,0 | Exam |
| SC 3.4. | Automated control systems in the power industry | 6,0 | Exam |
| SC 3.5. | Automation of power systems Part 2 | 5,0 | Exam |

| | | | |
|---|---|---|---|
| SC 3.6. | CAD in power engineering | 4,0 | Test |
| | **Total:** | **28** | |
| **Discipline block 04 " Electrical Insulation, Cable and Optical Fiber Equipment "** | | | |
| SC 4.1. | Physical basis of fiber optic technology | 6,0 | Exam |
| SC 4.2. | Electromagnetic and thermophysical processes in electrical insulation and cable systems | 4,0 | Exam |
| SC 4.3. | Equipment of modern electrical insulating laboratories | 3,0 | Exam |
| SC 4.4. | High-voltage electrical insulation systems | 5,0 | Exam |
| SC 4.5. | Testing techniques for electrical insulation, cable and fiber optic systems | 5,0 | Exam |
| SC 4.6. | Information technology in electrical insulation, cable and fiber optic technology | 5,0 | Test |
| | **Total:** | **28** | |
| **Discipline block "Energy Management and Energy-Efficient Technologies"** | | | |
| SC 5.1. | Renewable energy systems and secondary energy resources | 4,0 | Exam |
| SC 5.2. | Energy management and audit | 5,0 | Exam |
| SC 5.3. | Energy Policy of Ukraine and Energy Marketing | 4,0 | Exam |
| SC 5.4. | Quality of electric energy and quality management | 6,0 | Exam |
| SC 5.5. | Environmental aspects of energy | 5,0 | Exam |
| SC 5.6. | Accounting and measurement of energy parameters | 4,0 | Test |
| | **Total:** | **28** | |
| **Discipline block 13 "Renewable sources of energy "** | | | |
| SC 6.1. | Hydrogen power engineering and nanotechnology | 4,0 | Exam |
| SC 6.2. | Photovoltaic converters | 4,0 | Exam |
| SC 6.3. | Technique and experiment planning | 5,0 | Exam |
| SC 6.4. | Fundamentals of thermoelectricity and its application | 6,0 | Exam |
| SC 6.5. | Environmental aspects of energy | 4,0 | Test |
| SC 6.6. | Experimental studies of electrophysical processes | 5,0 | Exam |
| | **Total:** | **28** | |
| **Discipline block 14 «Technique and electrophysics of high voltages»** | | | |
| SC 7.1. | Physics of electrostatic processes and technologies | 3,0 | Exam |
| SC 7.2. | Calculation and design of magnetic pulse installations | 5,0 | Exam |
| SC 7.3. | Technique and experiment planning | 5,0 | Exam |
| SC 7.4. | High frequency current and ultrasound in the technique | 5,0 | Exam |
| SC 7.5. | The technique of strong electric and magnetic fields | 5,0 | Test |
| SC 7.6. | Experimental studies of electrophysical processes | 5,0 | Exam |
| | **Total:** | **28** | |
| **Discipline block 15 "Cybersecurity Technologies in Electric Power Engineering"** | | | |
| SC 8.1. | Modern technologies and methods of building relay protection and automation systems | 4,0 | Exam |
| SC 8.2. | Automation and cybersecurity of power systems Part 1 | 5,0 | Exam |
| SC 8.3. | Fundamentals of information security in the power industry | 4,0 | Exam |
| SC 8.4. | Automated control systems in power industry and their cyber security | 6,0 | Exam |
| SC 8.5. | Automation and cyber security of power systems Part 2 | 5,0 | Exam |
| SC 8.6. | CAD intelligent power systems | 4,0 | Test |
| | **Total:** | **28** | |
| **Total volume of components** | | **28** | |
| **Total volume of** educational-professional program | | **90** | |

## 2.2. Structural-logical scheme of the educational program



## 3. Form of certification of applicants for higher education

The certification of the graduates of the educational program of **specialty 141 " Electric Power Engineering, Electrical Engineering and Electromechanics "** is carried out in the form of defense of the qualification master's work and ends with the issuing of the document of the established model on awarding the master's degree with the qualification: **"Master of Electric Power Engineering, Electrical Engineering and Electromechanics "** related specialties. The certification is carried out openly and publicly.

The qualification work should represent the solution of a complex special-purpose task or practical problem in the field of electric power engineering, electrical engineering and electromechanics, which involves research and / or innovation and is characterized by uncertainty of conditions and requirements.

The qualification work should be verified for plagiarism using software and hardware, and should be placed in the repository of a higher educational institution or a relevant structural unit.

## 4. Matrix of compliance of program competencies to the components of the educational program

| | GT 1 | GT 2 | GT 3 | PT 1 | PT 2 | PT 3 | PT 4 | PT 5 | GT 4 | GT 5 | SC 1.1 | SC 1.2 | SC 1.3 | SC 1.4 | SC 1.5 | SC 1.6 | SC 2.1 | SC 2.2 | SC 2.3 | SC 2.4 | SC 2.5 | SC 2.6 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **GC 1** | | | | • | | | | • | | • | | | | | | | | | | | | | | |
| **GC 2** | • | • | | | | | | • | • | • | | | | | | | | | | | | | | |
| **GC 3** | • | • | | | | | • | | | • | | | | | | | | | | | | | | |
| **GC 4** | • | • | | | | | | | • | • | | | | | | | | | | | | | | |
| **GC 5** | | | | | • | | | | | • | | | | | | | | | | | | | | |
| **GC 6** | | | | | | | | | | • | | | | | | | | | | | | | | |
| **GC 7** | | | | • | • | • | • | • | • | • | | | | | | | | | | | | | | |
| **GC 8** | • | • | | | | | | | | • | | | | | | | | | | | | | | |
| **GC 9** | | | | | | • | | • | | • | | | | | | | | | | | | | | |
| **GC 10** | | | | | | • | | | | • | | | | | | | | | | | | | | |
| **GC 11** | | | | | | • | | | | • | | | | | | | | | | | | | | |
| **GC 12** | | | | | | | | | | • | | | | | | | | | | | | | | |
| **GC 13** | | | • | | | • | | | | • | | | | | | | | | | | | | | |
| **PC 1** | | | | | | | | • | • | • | | • | • | • | | | • | • | | • | | | | |
| **PC 2** | | | | | | • | | | | • | • | • | | • | | | | • | | | | | | |
| **PC 3** | | | | | | | • | | • | • | | | | • | | | | | • | | | | | |
| **PC 4** | | | | | | | • | • | | • | | | • | | | | • | • | | | • | • | | |
| **PC 5** | • | | | | • | | | • | | • | • | • | | | | | | | | | • | | | |
| **PC 6** | | | | | | • | • | | | • | | | | | | | | | • | | | • | | |

| | GT 1 | GT 2 | GT 3 | PT 1 | PT 2 | PT 3 | PT 4 | PT 5 | GT 4 | GT 5 | SC 1.1 | SC 1.2 | SC 1.3 | SC 1.4 | SC 1.5 | SC 1.6 | SC 2.1 | SC 2.2 | SC 2.3 | SC 2.4 | SC 2.5 | SC 2.6 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PC 7** | | ● | | | | | | ● | | ● | ● | ● | | | | | | | | | ● | | | |
| **PC 8** | ● | | | ● | | | | ● | | ● | | | | | ● | ● | | | | ● | | | | |
| **PC 9** | | | | | | ● | | | | ● | | | ● | | | ● | | | | | ● | | | |
| **PC 10** | | ● | | | | | | ● | | ● | | | | | | | | | | ● | | | | |
| **PC 11** | | | | ● | | | | | | ● | | | | | | | | | | | | | | |
| **PC 12** | | | | | | ● | | | | ● | | | | | | | | | | | | | | |
| **PCc13** | | | | | | | | | | | ● | ● | ● | ● | ● | ● | | | | | | | | |
| **PCc14** | | | | | | | | | | | | | | | | | ● | ● | ● | ● | ● | ● | | |
| **PCc 15** | | | | | | | | | | | | | | | | | | | | | | | | |
| **PCc 16** | | | | | | | | | | | | | | | | | | | | | | | | |
| **PCc 17** | | | | | | | | | | | | | | | | | | | | | | | | |
| **PCc 18** | | | | | | | | | | | | | | | | | | | | | | | | |
| **PCc 19** | | | | | | | | | | | | | | | | | | | | | | | | |
| **PCc 20** | | | | | | | | | | | | | | | | | | | | | | | | |

## 5. The Matrix of Providing Program Learning Outcomes (PLO) by the relevant components of the curriculum

| | GT 1 | GT 2 | GT 3 | PT 1 | PT 2 | PT 3 | PT 4 | PT 5 | GT 4 | GT 5 | SC 1.1 | SC 1.2 | SC 1.3 | SC 1.4 | SC 1.5 | SC 1.6 | SC 2.1 | SC 2.2 | SC 2.3 | SC 2.4 | SC 2.5 | SC 2.6 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PLO 1** | | | | | | | ● | ● | | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | | | | | | |
| **PLO 2** | | | | | | | ● | ● | ● | ● | ● | ● | | ● | ● | | | ● | | | ● | ● | | | | | | |
| **PLO 3** | | | | | | | | | | ● | ● | ● | ● | | | | | | | | | | | | | | | |
| **PLO 4** | | ● | | | | | | | ● | ● | | | | | | | | | | | | | | | | | | |
| **PLO 5** | | | | | | | | | | ● | | | | | | | | | | | | | | | | | | |
| **PLO 6** | | | | | | | ● | | | ● | | | | | | | | | ● | | | | | | | | | |
| **PLO 7** | | | | ● | ● | | ● | ● | ● | ● | | | | | | | | | ● | | ● | ● | | | | | | |
| **PLO 8** | ● | | | | | | | | | ● | | | | | | | | | | | | | | | | | | |
| **PLO 9** | | | ● | | | ● | | | | ● | | | | | | | | | | ● | | | | | | | | |
| **PLO 10** | | | | ● | ● | | | | | ● | | | | | | | | | | | | | | | | | | |
| **PLO 11** | | | | ● | | ● | | | | ● | | ● | | | | | | | | | | | | | | | | |
| **PLO 12** | | | | ● | ● | ● | | | | ● | | ● | | ● | ● | | | | | | | | | | | | | |
| **PLO 13** | | ● | | | | | | | ● | ● | | | | | ● | | | | | ● | ● | ● | | | | | | |
| **PLO 14** | | | | | | | ● | ● | | ● | | | | | | | | | | | | | | | | | | |
| **PLO 15** | | | | ● | | ● | | | | ● | | | | | | | | | | | | | | | | | | |
| **PLO 16** | | | | ● | | | | | | ● | | | | | | | | | | | | | | | | | | |

| | GT 1 | GT 2 | GT 3 | PT 1 | PT 2 | PT 3 | PT 4 | PT 5 | GT 4 | GT 5 | SC 1.1 | SC 1.2 | SC 1.3 | SC 1.4 | SC 1.5 | SC 1.6 | SC 2.1 | SC 2.2 | SC 2.3 | SC 2.4 | SC 2.5 | SC 2.6 | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **PLO 17** | | | | | | | ● | ● | | ● | ● | ● | ● | ● | ● | ● | | | | | | | | | | | | | |
| **PLO 18** | | | | | | | ● | ● | ● | ● | | | | | | | ● | ● | ● | ● | ● | ● | | | | | | |
| **PLO 19** | | | | | | | | | | ● | | | | | | | | | | | | | | | | | | |
| **PLO 20** | | ● | | | | | | | ● | ● | | | | | | | | | | | | | | | | | | |
| **PLO 21** | | | | | | | | | | ● | | | | | | | | | | | | | | | | | | |
| **PLO 22** | | | | | | | ● | | | ● | | | | | | | | | | | | | | | | | | |
| **PLO 23** | | | | ● | | | ● | ● | ● | ● | | | | | | | | | | | | | | | | | | |
| **PLO 24** | ● | | | | | | | | | ● | | | | | | | | | | | | | | | | | | |
| **PLO 25** | | | ● | | | ● | | | | ● | | | | | | | | | | | | | | | | | | |