Syllabus
Course Program

Electric Devices

Specialty
141 – Electric Power Engineering, Electrical Engineering and Electromechanics

Institute
Institute of Energy, Electronics and Electromechanics

Educational program
Electric Drive, Mechatronics and Robotics

Department
Electrical Apparatus
(127 ???)

Level of education
Bachelor's level

Course type
Special (professional), Mandatory ???

Semester
5

Language of instruction
English

Lecturers and course developers

Michael Pantelyat

Mykhailo.Panteliat@khpi.edu.ua
PhD (Physics & Mathematics), Senior Researcher, Associate Professor

Total work experience - about 40 years. Author of more 200 scientific papers. Fellow of the Alexander von Humboldt Foundation (Alexander von Humboldt Stiftung, Germany). Leading lecturer in the disciplines: "Design of Electromechanical Systems ", "Electric Devices", and others.
More about the lecturer on the department's website

General information

Summary

The course is intended to acquaint Bachelor students with the conceptual apparatus in the field of electrical devices based on international electrical terminology, functions of electrical devices and their parts, market trends and classification of electrical devices, protective properties and protection of electrical equipment, requirements for electrical devices, markings, designations.

Course objectives and goals

Providing comprehensive theoretical information on the purpose, structure, principle of operation, features of application and selection criteria for low and medium voltage electromechanical devices for switching, control and protection and the acquisition of practical skills in the use of electrical devices.

Format of classes

Lectures, laboratory classes. Final control in the form of an exam/test ???.

Competencies

Ability to abstract thinking, analysis and synthesis. Ability to apply knowledge in practical situations. Ability to communicate both orally and in writing. Ability to search, process and analyze information from various sources. Ability to identify, pose and solve problems. Ability to work in a team. Ability to work

autonomously. The ability to solve practical problems using automated design and calculation systems (CAD). The ability to solve practical problems involving the methods of mathematics, physics and electrical engineering. The ability to solve complex specialized tasks and practical problems related to the operation of electric machines, devices and automated electric drives. The ability to develop projects of electric power, electrotechnical and electromechanical equipment in compliance with the requirements of legislation, standards and specifications. The ability to perform professional duties in compliance with the requirements of the rules of safety, labor protection, industrial sanitation and environmental protection. Awareness of the need to increase the efficiency of electric power, electrotechnical and electromechanical equipment. Awareness of the need to constantly expand one's own knowledge of new technologies in electric power, electrical engineering and electromechanics. The ability to promptly take effective measures in emergency situations in electric power and electromechanical systems.

Learning outcomes

Know the principles of operation of electric machines, devices and automated electric drives and be able to use them to solve practical problems in professional activities. Know the basics of electromagnetic field theory, methods of calculating electric circuits and be able to use them to solve practical problems in professional activities. To carry out the analysis of processes in electric power, electrotechnical and electromechanical equipment, relevant complexes and systems. Find the necessary information in scientific and technical literature, databases and other sources of information, evaluate its relevance and reliability. Communicate freely about professional problems orally and in writing, discuss the results of professional activity with specialists and non-specialists, argue one's position on debatable issues. Understand and demonstrate good professional, social and emotional behavior, follow a healthy lifestyle. Solve complex specialized problems in the design and maintenance of electromechanical systems, electrical equipment of power stations, substations, systems and networks. Be able to learn independently, acquire new knowledge and improve skills in working with modern equipment, measuring equipment and application software. Apply appropriate empirical and theoretical methods to reduce losses of electrical energy during its production, transportation, distribution and use. Know and use packages of application programs for conducting practical calculations of electric machines, electric devices, electrical equipment of railways and their components.

Student workload

The total volume of the course is 90 hours (3 ECTS credits): lectures - 32 hours, laboratory classes - 16 hours, self-study - 42 hours. ???

Course prerequisites

Previous courses that are necessary for successful course completion: Physics, Mathematics, Theoretical Foundations of Electrical Engineering, Electrical Materials.

Features of the course, teaching and learning methods, and technologies

Information and computer technologies, mobile laboratory stands with modern electrical devices, electrical measuring instruments and digital two-channel oscilloscopes are widely used in lectures and laboratory classes to enhance the educational and cognitive activities of students in the study of the discipline.

Program of the course

Topics of the lectures

Topic 1. Key features of international terminology for electrical devices.
International Electrotechnical Vocabulary and other terminological sources. Abbreviations of terms and letter designations of physical quantities. Features of the wording of some terms.
Topic 2. Functions and main parts of electrical devices.
Main circuit, control circuit, auxiliary circuit. Pole and port of the electric device. Contacts of electrical devices. Main contact, control contact and auxiliary contact. Electrical contact. Contact resistance.
Topic 3. Arc-quenching systems of switching devices.

Processes that occur when closing and opening contacts. Basic rules for building contact systems and arc suppression devices. Arc dampers. Electrodynamic loops as a means of accelerating the movement of the arc into the chamber. Magnetic blast systems. Vacuum interrupter

Topic 4. Terminals of electrical devices.

Screw-type terminals. Dual connection terminals. Screwless-type terminals.

Topic 5. Actuators of electrical devices.

Apparatus with electrical and non-electrical control. Electromagnetic actuators. Unpolarized and polarized actuators. Monostable and bistable actuators. Generalized structure of the switching device.

Topic 6. Market trends and classification of electrical devices.

Development of electricity production and trends in the market of electrical devices. Electromechanical switching devices. Semiconductor switching devices. Hybrid switching devices.

Topic 7. Electromechanical low voltage switchgear. Fuses. Disconnectors, circuit breakers and fuse combinations.

Purpose, principle of operation, design. Characteristics of fuses. Fuses for houdehold and industrial use. Disconnectors, switches and fuse combinations. Classification and designation.

Topic 8. Electromechanical low voltage switchgear. Circuit-breaker for industrial and household use. Circuit-breaker controlled by differential current.

Design, application categories of industrial breakers. Performance characteristics. Modular construction and accessories for household breakers. Schemes of functionally dependent and functionally independent breakers controlled by differential current.

Topic 9. Electromechanical low voltage switchgear. Contactors and starters.

Purpose and principle of operation. Nominative characteristics. Switching frequency and wear resistance. Categories of application. Electrical circuits of combined and protected starters.

Topic 10. Electromechanical low voltage switchgear. Electromagnetic relays. Control circuit devices.

Purpose, principle of operation, design. Main characteristics.

Topic 11. Electromechanical medium voltage switching devices. Circuit breaker. Disconnectors and earthing switches. Switches-disconnectors.

Main quantitative characteristics of medium voltage switching devices. Nominative sequences of operation. Arc-quenching environments and market dynamics.

Topic 12. Medium voltage electromechanical switching devices. Fuses. Combinations with fuses.

Contactors. Purpose, principle of operation, design.

Topics of the workshops

Workshops within the discipline is not provided.

Topics of the laboratory classes

Topic 1. Workshop on the use of two-channel digital oscilloscope.

Topic 2. Study of an AC contactor.

Topic 3. Study of a miniature circuit breaker (MCB) of household and similar applications for protection against overcurrents.

Topic 4. Study of devices controlled by differential currents (RCCB, RCBO).

Topic 5. Study of interface relays.

Topic 6. Study of a low voltage vacuum contactor.

Self-study

Acquaintance with the electronic version of the International Electrotechnical Vocabulary - IEV.
Acquaintance with the international standards IEC concerning the electric equipment

Course materials and recommended reading

Compulsory reading

1	Klymenko B.V. Electrical Devices. Electromechanical switching, control and protection equipment. General course (second edition, revised and supplemented): Textbook. – Kharkiv: Tochka Publishing House, 2013. – 400 p. (in Ukrainian).

2	Klymenko B.V. Switching Equipment, Control Equipment, Fuses. Terms, interpretations, comments: Textbook. – Kharkiv: Talent Publishing House, 2008. – 228 p. (in Ukrainian).
3	Klymenko B.V. Electrical and Magnetic Devices, Electrical Accessories, Electrical Installations. Terms, interpretations, comments: Textbook. – Kharkiv: Tochka Publishing House, 2009. – 272 p. (in Ukrainian).
4	International Standards IEC 60027; IEC 60269-1: Ed. 3.1, 2005-04; IEC 60269-4: Third edition, 1986; IEC 60282-1: Ed. 7.0, 2009-10; IEC 60364-1: Fourth edition, 2001-08; IEC 60529: Ed. 2.1, 2001-02; IEC 60898-1: Ed. 1.2, 2003-07; IEC 60947-1: Fourth edition 2004-03; IEC 60947-2: Third edition, 2003-04; IEC 61008-1: Ed. 2.1, 2002-10; IEC 61009-1: Ed. 2.1, 2003-02; IEC 61810-1: Ed.3.

Assessment and grading

Criteria for assessment of student performance, and the final score structure

Description of the final score structure, course requirements, and necessary steps to earn points, especially paying attention to self-study and individual assignments.

Grading scale

Total points	National	ECTS
90–100	Excellent	A
82–89	Good	B
75–81	Good	C
64–74	Satisfactory	D
60–63	Satisfactory	E
35–59	Unsatisfactory (requires additional learning)	FX
1–34	Unsatisfactory (requires repetition of the course)	F

Norms of academic integrity and course policy

The student must adhere to the Code of Ethics of Academic Relations and Integrity of NTU "KhPI": to demonstrate discipline, good manners, kindness, honesty, and responsibility. Conflict situations should be openly discussed in academic groups with a lecturer, and if it is impossible to resolve the conflict, they should be brought to the attention of the Institute's management.
Regulatory and legal documents related to the implementation of the principles of academic integrity at NTU "KhPI" are available on the website: http://blogs.kpi.kharkov.ua/v2/nv/akademichna-dobrochesnist/

Approval

Approved by	Date, signature	Head of the department Yevgen BAIDA
	Date, signature	Guarantor of the educational program Olena YURYEVA