Syllabus of the educational component

Course Program

Fundamentals of Power Electric Engineering

Specialty
141 – Electric power, electrical engineering and electromechanics

Institute
Scientific and Educational Institute of Energy, Electronics and Electromechanics

Educational program
Electromechanics

Department
Electrical machines (126)

level of higher education
first (bachelor's)

Course type
Mandatory special (professional)

Semester
2

Language of instruction
English

Lecturers and course developers

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Doct. Tech. Sciences, Associate Professor, Professor of the Electrical Machines Department.

She has more than 300 publications in scientific journals, 10 patents, 8 monographs and manuals. May of the title "ING-PAED IGIP" (International teacher in the gallery of engineering pedagogy IGIP). Basic courses - Electrical machines, Electrical machines and devices, Reliability and diagnostics, Electric generators for HPPs and mini-HPPs, Power supply of industrial enterprises, Operation and modes of operation of power plants electrical equipment, Prospects for the use of superconductivity in electromechanics.
Learn more about the teacher on the department's website

General information

Summary

The discipline is dedicated to the student's initial acquaintance with power supply systems, where electric machines and transformers are used; studies the generation, distribution and transmission of electricity, introduces students to electrical equipment (electric machines, transformers, etc.) of power plants and industrial enterprises, which is necessary for the formation of a modern general engineering level of an specialist-electromechanics. In the process of studying the discipline, the student acquires knowledge about the current level, problems and directions of development of the electric power industry in Ukraine and various countries of the world, about electrical equipment (electric machines, transformers, etc.), which ensure the production, distribution, transmission and consumption of electricity, which is the basis of modern civilization.

Course objectives and goals

The purpose of studying the discipline is to prepare bachelors in specialty 141 "Power Engineering, Electrical Engineering and Electromechanics", which provides a base of theoretical and practical knowledge of future professionals in the field of manufacture and use of electric machines (generators and motors) and transformers, both in production and in operation.

Format of classes

Lectures and practical works, independent work, consultations. The final control is an exam.

Competences

Ability to navigate in international standards, norms and technical conditions of electrical and electromechanical equipment operation. Ability to evaluate energy efficiency and economic modes of operation of electrical and electromechanical equipment. Know the basic rules of installation of overhead power lines and laying of cable networks in industrial enterprises, the purpose of transformers in electrical networks.
Ability to abstract thinking, analysis and synthesis.
Ability to communicate in a foreign language.
Ability to work in a team.
Ability to work autonomously.
The ability to realize one's rights and responsibilities as a member of society, to be aware of the values of a civil (free democratic) society and the need its sustainable development, rule of law, rights and freedoms person and citizen in Ukraine.
The ability to preserve and multiply moral, cultural, scientific values and achievements of society on the basis of understanding the history and patterns of development of the subject area, its place in the general system of knowledge about nature and society and in the development of society, equipment and technologies.
The ability to solve complex specialized tasks and practical problems related to the operation of electric machines, devices and automated electric drives.
Awareness of the need to improve efficiency electric power, electrotechnical and electromechanical equipment.
Awareness of the need to constantly expand own knowledge about new technologies in electricity, electrical engineering and electromechanics.
The ability to promptly take effective measures in emergency (emergency) situations in electric power and electromechanical systems.

Learning outcomes

Students must be able to determine the principles of construction and normal operation of elements of electrical and electromechanical electrical equipment. Be able to analyze the strategy and tactics of solving professional problems by experienced workers in the field of power engineering and electromechanics.
Know the means of generation, transmission and distribution of electricity, operating cycles of electricity generation at different types of power plants, basic electrical equipment of power plants, substations and industrial enterprises. Know the basic rules of installation of overhead power lines and laying of cable networks in industrial enterprises, the purpose of transformers in electrical networks.
Know the problems of regulating the balance of electricity in the grid.
Communicate freely about professional problems in the national and Ukrainian languages orally and in writing, discuss the results of professional activity with specialists and non-specialists, argue one's position from discussion points questions. Understand the basic principles and tasks of technical and environmental safety of electrical engineering and electromechanics objects. To understand the importance of traditional and renewable energy for the successful economic development of the country.
Understand the principles of European democracy and respect for the rights of citizens, take them into account when making decisions.

Student workload

The total scope of the discipline is 120 hours. (4 ECTS credits): lectures – 32 hours, practical work – 16 hours; independent work - 72 hours.

Course prerequisites

Introduction to the specialty, Higher mathematics, Physics, Informatics, computer engineering and programming, Electrotechnical materials, Fundamentals of metrology and electrical measurements.

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

Different teaching methods are used in lectures and practical classes in accordance with the content of the work program and to enhance the educational and cognitive activities of students in the discipline (active forms of classes, methods of interaction between teacher and students): lecture, lecture-dialogue, practical classes, interview, consultation.
The practical classes use a varied approach to learning, game methods; and focus on the application of information technologies in solving general issues of the electric power industry. A public defense of an individual task is carried out.

Program of the course

Topics of the lectures

Topic 1. Electricity generation technology
Topic 1.1. General information about power supply systems. Generation, distribution, transmission and consumption of electricity. Categories of power supply reliability. Reserve power supply channels taking into account the reliability category of power receivers
Topic 1.2. Types of power plants. Operating cycles of electricity generation at thermal power plants and combined heat and power plants (CHPs). Impact of TPPs and CHPs on ecology.
Topic 1.3. Operating cycles of electricity generation at nuclear power plants. Types of reactors. Problems and means of storage of spent nuclear fuel. Assessment of the prospects for the use of nuclear power plants in modern world and national electricity. The impact of nu-clear power plants on the environment.
Topic 1.4. Operating cycles of electricity generation at hydroelectric power plants and hydro-accumulating power plants. Assessment of prospects for the use of hydropower plants and hydro-accumulating power plants in modern world and national electricity. Impact of hydropower plants and hydro-accumulating power plants on the environment.
Topic 1.5. Means of electricity generation using renewable energy sources. Wind, solar, complex and hydroelectric power plants, mini- and micro-hydropower plants, bio- and geothermal electricity. The role and prospects of the implementation of non-traditional power sources in the general electricity system on the example of Ukraine.

Topic 2. The main power equipment of stations and industrial enterprises
Topic 2.1. Basic laws used in electricity, losses in electrical equipment. Modes of electrical equipment operation.
Topic 2.2. Types of basic power plants electrical equipment and substations: electric generators and engines, transformers.
Topic 2.3. Powerful transformers, purpose, design, principle of operation, cooling systems.

Topic 3. Electricity distribution systems
Topic 3.1. Overhead power lines. Rated power of overhead power lines. Types of transmission line towers, equipment and rules of their creation.
Topic 3.2. Cable networks. Rules for laying cable networks at industrial en-terprises. Insulating materials for cables and conductors.
Topic 3.3. Reactive power compensation in power grids. Assignment of re-active power. The main sources and consumers of reactive power. Reactive power compensation systems.

Topics of the workshops

Topic 1.
Designation of elements of electric circuits (electrical machines, switching, measuring and protective devices). Electrical materials used for electrical machines.
Topic 2.
Study of the design of transformers and marking of transformers. Basic parameters of transformers. Block transformers and transformers for power plants' own needs.
Topic 3.
Study of purpose, designs and types of transformer substations. Features of assembly and construction of complete transformer substations.
Topic 4.

Types of power plants. Main equipment of engine rooms of power plants.

Topic 5.

Design features of synchronous generators of various power plants. Features of the generators design of hydraulic and hydro-accumulating power plants.

Topic 6.

The concept of "reactive power compensation". Appointment of reactive power compensation. Synchronous compensators.

Topic 7.

Advantages and disadvantages of renewable electricity. Analysis and selection of types of power generators for wind power plants.

Topic 8.

Prospects for the development of the electric power industry. New types of electrical sources, electrical machines and transformers in the future.

Analysis of performance and protection of individual tasks

Self-study

The discipline provides for the implementation of the calculation task «Analysis and prospects of electric power development of the country» according to methodical instructions [9]. The calculation task is drawn up in the form of a report on the performance of independent work. Successful defense of the calculation task is valued at 30 points and is included in the examination grade.

Course materials and recommended reading

1. Jacek F. Gieras. Electrical Machines. Fundamentals of Electromechanical Energy Conversion. – Published 2020 by CRC Press. – 450 p. [Electronic resource]. URL: https://www.routledge.com/Electrical-Machines-Fundamentals-of-Electromechanical-Energy-Conversion/Gieras/p/book/9780367736941.
2. Shevchenko VV. Basics of electric power engineering. Beginning. Training manual. Kharkiv, 2022. – 256 p. [Electronic resource]. URL: https://zenodo.org/record/6465750
3. Official site of the NTU "KhPI» Electric Machines department. [Electronic resource]. URL: http://web.kpi.kharkov.ua/elmash.
4. Elements of Electrical Machines. Lecture Notes. Subject Code: BEE 1301. For 3rd Semester Mechanical Engineering and Production Engineering students. VEER Surendra SAI university of technology burla, Odisha, India. – Department of Electrical Engineering. [Electronic resource]. URL: https://www.vssut.ac.in/lecture_notes/lecture1423454727.pdf
5. Adneli Consultant, S.L. Electrical Machines – Basic Theory. – License: CC-BY-SA 4.0 International - Creative Commons, Attribution Share-alike, 2021. – 124 p. [Electronic resource]. URL: https://www.researchgate.net/publication/358046144_Book_on_Electrical_Machines_Basic_Theory
6. Electrical Machines and their Applications Fourth Edition. – Pergamon Press, 2016. – 693 p. https://handoutset.com/wp-content/uploads/2022/02/Electrical-Machines-and-their-Applications-by-John-Hindmarsh.pdf
7. Electricity quality and its provision – Balance of active and reactive power. [Electronic resource]. URL: https://forca.ru/knigi/arhivy/kachestvo-elektroenergii-i-ego-obespechenie-7.html
8. Lessons in Electric Circuits. Vol. I – Direct Current (DC). Vol. II – Alternating Current (AC). [Electronic resource]. URL: https://www.allaboutcircuits.com/textbook/
9. Basic equipment and technology of electricity generation at industrial enterprises and power plants. Test questions, calculation tasks and guidelines for the discipline "Fundamentals of Power Electric Engineering" for full-time students in the specialty 141 – Energy, Electrical Engineering and Electromechanics in the specialty "Electric Machines" / Compilers Shevchenko V. V., Yurieva O. Yu. – Kharkiv: NTU "KhPI", 2022. – 18 p.

Evaluation system

Criteria for evaluating student performance and distribution of points

100% of the final grade consists of the results of the exam assessment (30 %) and the current assessment (70 %). The exam is conducted according to exam tickets in oral form. The current evaluation consists of evaluations for surveying in lectures (20 points), surveying and activity in practical classes (20 points), defense of the calculation task (30 points).
Total 100 points.

Rating scale

Total points	National assessment	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

The syllabus has been agreed	31.08.2023	Head of Department Volodymyr MILIKH
	31.08.2023	Guarantor of the educational program Olena Yuryeva