



Syllabus Course Program



Fundamentals of energy management

Specialty

141 – Electric Power Engineering, Electrical Engineering and Electromechanics

Institute

Institute of Education and Science in Power Engineering, Electronics and Electromechanics

Educational program

Electrical Power Engineering. Electric Power Stations,

Department

Electric Power Stations (130)

Level of education

Bachelor's level.

Course type

Special (professional), Optional

Semester

6

Language of instruction

English, Ukrainian

Lecturers and course developers



Olexii Bulhakov

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Assistant

Author of more than 20 scientific publications and educational and methodological works. Leading lecturer in the disciplines: "Fundamentals of thermography", "Energy management and audit", "Renewable energy sources and secondary energy resources"

[More about the lecturer on the department's website](#)

General information

Summary

The course offers an overview of the basic principles and practical aspects of energy management, taking into account current trends in the energy sector. Students will learn the theoretical foundations of energy resource management, strategies for efficient energy use, and methods for optimizing energy processes. The course examines key concepts of energy management, including planning, monitoring, analysis, and control of energy systems. Particular attention is paid to means of reducing energy losses, effective demand management, and the implementation of energy-saving technologies.

Students will have the opportunity to familiarize themselves with modern energy audit tools and methodologies, as well as learn how to develop strategies to improve energy efficiency and create sustainable energy systems in various areas of activity. The course is aimed at developing skills in energy resource management, taking into account the requirements of the modern energy market and environmental aspects.

Course objectives and goals

Purpose.

Formation of knowledge about the possibilities of applying energy management and modern energy saving technologies in order to increase the energy efficiency of individual technological processes, the work of municipal utilities and industrial enterprises.

Objectives.

Know:

- the causes of losses in real systems of heat, water, electricity supply, in compressed air systems and other energy supply systems of enterprises;
- ways to increase energy efficiency in systems of renewable energy sources, industry and municipal utilities;
- methods for improving the environmental performance of power plants;
- information about the latest technologies and equipment

Be able to:

- determine the relationship between the use of energy carriers and the volume of output;
- possess the mechanism for using regression analysis and the cumulative sum;
- determine indicators of the efficiency of the use of energy carriers of work processes in individual nodes of installations;
- determine and evaluate reserves for increasing the efficiency of the use of energy resources for municipal utilities and industry.
- determine the economic indicators of the installations and develop recommendations for their improvement;
- determine the environmental indicators of the thermal power installations and develop recommendations for their improvement

Format of classes

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

Competencies

Program competencies according to the educational program:

K01. Ability to abstract thinking, analysis and synthesis.

K05. Ability to search, process and analyze information from various sources.

K06. Ability to identify, pose and solve problems.

K11. Ability to solve practical problems using computer-aided design and calculation systems (CAD) as well as micro- and nanosystems technology.

K28. Obtaining and using professional knowledge and understanding related to conducting an energy audit, developing and implementing energy saving measures and increasing the energy efficiency of various facilities and energy management systems

Learning outcomes

Program learning outcomes according to the educational program:

PR02. Know and understand the theoretical foundations of metrology and electrical measurements, the principles of operation of automatic control devices, relay protection and automation, have the skills to perform appropriate measurements and use the specified devices to solve professional tasks.

PR07. Analyze processes in electrical power, electrical engineering and electromechanical equipment, relevant complexes and systems.

PR09. Be able to assess the energy efficiency and reliability of electrical power, electrical engineering and electromechanical systems.

PR18. Be able to independently learn, master new knowledge and improve skills in working with modern equipment, measuring equipment and applied software.

PR27. Know and understand the processes of energy audit, development and implementation of energy saving measures and energy efficiency improvement, development and implementation of an energy management system.

Student workload

The total scope of the discipline is 150 hours. (5 ECTS credits): lectures – 48 hours, practical work – 12 hours, laboratory work 12 hours, independent work – 78 hours.

Course prerequisites

Disciplines of bachelor's level training in specialty 141 "Electroenergetics, electrical engineering and electromechanics".

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

Lectures are conducted interactively using multimedia technologies. Practical classes use a project-based approach to learning, involve teamwork, focus on the use of information technologies, and students also have optional tasks that require the use of new, deeper skills than those in the course, for which they can receive additional points. Educational materials are created together with students through the Whiteboard of the Microsoft 365 educational platform with shared access. Practical classes and independent work use the Microsoft 365 package, available to all students of NTU "KhPI".

Program of the course

Topics of the lectures

Content module 1. Energy. Energy supply. Energy conservation

Objectives of the educational discipline. The significance of this educational discipline for ensuring other professional educational disciplines. The volume of educational material, types of classes and organization of work for its mastery

Topic 1. Structure and trends in the development of energy. Energy and the environment.

Topic 2. Energy management as a scientific and practical activity. System of public administration in the field of energy consumption and energy supply.

Topic 3. Regulatory framework and theoretical foundations of energy conservation. Energy efficiency criteria. International and domestic standards.

Topic 4. Requirements for an energy manager. Common and specific aspects of the work of an energy manager and auditor.

Content module 2. Survey of energy supply systems.

Topic 5. Survey of energy supply systems. Main methods and sources of information.

Topic 6. Energy balance of the enterprise. Inspection of heat supply systems

Topic 7. Inspection of ventilation systems and pumping units. Assessment of the correctness of the choice. Methods for determining and calculating electricity losses in these systems.

Topic 8. Inspection of power supply and lighting systems. Calculation of losses in equipment. Equipment selection criteria.

Content module 3. Organization of energy management at the enterprise.

Topic 9. Methodology for organizing energy management at the enterprise. Structure and algorithm for creating an energy management system.

Topic 10. Organization of energy consumption control. Development of an energy accounting map.

Energy accounting centers. Methods for analyzing energy consumption: regression analysis, cumulative sum, etc.

Topic 12. Methods for controlling energy consumption. Principles and methods of measurements. Basics of choosing measuring equipment.

Topic 13. Development and implementation of energy consumption management systems. APCS, ASKOE. Hierarchical structure.

Content module 4. Economic aspects of energy management.

Topic 14. The concept of an investment project and project analysis. The main phases of projects. Types of investments. The structure of an investment project.

Topic 15. Economic assessment of energy-saving projects. Project horizon. Determination of payback periods. Typical payback periods for major measures for municipal and industrial facilities.

Topics of the workshops

Topic 1. Calculation of the energy balance of the enterprise.

Topic 2-3. Analysis of the energy audit of a utility company.

Topic 4-5. Rationing and normalization. Regression analysis.

Topic 6-7. Financial assessment of an energy-saving project.

Topics of the laboratory classes

Topic 1. Calculation of the energy balance of the enterprise.

Topic 2-3. Analysis of the energy audit of a utility company.

Topic 4-5. Rationing and normalization. Regression analysis.

Topic 6-7. Financial assessment of an energy-saving project.

Self-study

Individual task – Estimated task

Topic: "Analysis of the energy audit report"

The task is defended in the form of a report using prepared presentation materials.

Deadline: 8 weeks

Take online courses on educational platforms on the subject of the discipline (optional):

Online course [ISO 50001:2018. Energy management system](#) on the Udemy platform, free access to the platform materials is provided by submitting registration lists by the teacher to the director of the scientific and technical library of NTU "KhPI"

Online course [Energy management for real estate. Methods and digital tools](#) on the Coursera platform, free access to the platform materials is provided by registering with an email address in the NTU "KhPI" domain.

Course materials and recommended reading

Basic literature:

Nemirovsky I. A. Energy saving and energy audit / I. A. Nemirovsky, V. L. Malyarenko. – Kharkiv: NTU "KhPI", 2011. – 341 p.

Manual for the implementation of resource-efficient and cleaner production methods – Kyiv: Center for Resource-Efficient and Clean Production, 2017. – 76 p.

Information resources on the Internet:

State Energy Efficiency [Electronic resource]. – 2019. – Resource access mode: <https://saee.gov.ua/>.

Association of Energy Auditors of Ukraine [Electronic resource]. – 2019. – Resource access mode: <https://aea.org.ua/>.

Assessment and grading

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

100 points of the final assessment consist of the results of the current assessment (60 points) and the final assessment in the form of an exam (40 points).

Current assessment: individual assignment (50 points) and its defense (10 points) (additional points for having a certificate of completion of the online course with thematic compliance, for participation in student research paper competitions and Olympiads on the subject of the discipline).

Exam: written assignment (3 questions from the theory) and oral report.

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
Oleksandr LAZURENKO

Date, signature

Guarantor of the educational program
Halyna OMELYANENKO