Національний технічний університет України
«КИЇВСЬКИЙ ПОЛІТЕХНІЧНИЙ ІНСТИТУТ
імені ІГОРЯ СІКОРСЬКОГО»

Automation of electrical and mechatronic complexes

Technology of energy production from traditional raw materials and alternative energy sources

Work program of the academic discipline (Silabus)

Details of the discipline

Level of higher education	***Second (master's) degree***
Field of expertise	*14 Electrical engineering*
Specialty.	*141 Electric Power Engineering, Electrotechnics and Electromechanics*
Educational program	***Engineering of Intellectual Electrotechnical and Mechatronic Complexes***
Status of the discipline	*Selective*
Form of study	*In-person/remote/mixed*
Year of study, semester	*1st year, spring*
Scope of the discipline	*4 credits / 120 hours*
Semester control / control measures	*credit, ICR*
Class schedule	*http://rozklad.kpi.ua/Schedules/ViewSchedule.aspx?v=9e264081-809d-440d-85e0-25117acbbf0b*
Language of instruction	*Ukrainian*
Information about course leader / teachers	Lecturer: *Leonid Mazurenko, 3662491@gmail.com* Practical classes: *Leonid Mazurenko, 3662491@gmail.com*
Placement of the course	*Sikorsky platform*

Program of the discipline

1. Description of the discipline, its purpose, subject matter and learning outcomes

The main objective of teaching the discipline "Technology of energy production from traditional raw materials and alternative energy sources"

is the development of students' competencies in the system of basic knowledge in the field of electricity production from traditional raw materials and alternative energy sources.

The subject of the discipline is the ways, methods and technologies of electricity generation, economic efficiency and environmental feasibility of construction and operation of power plants based on traditional, unconventional and renewable energy sources.

Mastering this material will help students to correctly determine the role and place of traditional, unconventional and renewable energy sources as components of individual energy supply systems and the country's fuel and energy complex as a whole, to determine the mechanisms of influence on the development of energy and the state, including the environmental and social spheres of its activities.

Program learning outcomes:

- **Competencies:**
  - ability to search, process and analyze information from various sources (K01);
  - ability to apply knowledge in practical situations (K03);

- ability to make informed decisions (K05);
- ability to learn and master modern knowledgeK06);
- ability to communicate with representatives of other professional groups of different levels (K10);
- the ability to apply existing and develop new methods, techniques, technologies and procedures to solve engineering problems in the electric power industry, electrical engineering and electromechanics (K11);
- the ability to analyze technical and economic indicators and expertise of design and engineering solutions in the field of electricity, electrical engineering and electromechanics.(K13);
- the ability to understand and take into account social, environmental, ethical, economic and commercial considerations that affect the implementation of technical solutions in the electric power industry, electrical engineering and electromechanics (K15).

- **Skills:**

- to reproduce processes in electric power, electrical and electromechanical systems in their computer modeling (PLO 01);
- outline a plan of measures to improve the reliability, safety of operation and service life of electric power, electrical and electromechanical equipment and related complexes and systems (PR02);
- communicate fluently orally and in writing in the state and foreign languages on modern scientific and technical problems of electric power, electrical engineering and electromechanics (PLO 11);
- demonstrate an understanding of legal acts, norms, rules and standards in the field of electricity, electrical engineering and electromechanics (PO12);
- Identify the main factors and technical problems that may hinder the implementation of modern methods of controlling electric power, electrical and electromechanical systems
systems (WP13).

2. Prerequisites and post-requisites of the discipline (place in the structural and logical scheme of study in the relevant educational program)

Interdisciplinary links: the discipline is taught on the basis of knowledge and skills acquired by students while studying credit modules in such disciplines as Higher Mathematics, Physics, etc. The knowledge gained in the course of studying the discipline is used in course and diploma design

3. Content of the discipline - Technology of energy production from traditional raw materials and alternative energy sources.

Section 1. Energy resources and basic technologies of their use

Topic 1.1. Energy resources.

Topic 1.2. Basic technologies for the use of energy resources.

Section 2: Technologies for the use of unconventional and renewable energy sources

Topic 2.1. Technology of water energy utilization.

Topic 2.2 Technology of wind energy utilization.

Topic 2.3: Technology of solar energy use: conversion of solar energy into heat.

Topic 2.4. Solar energy technology: conversion of solar energy into electricity.

Topic 2.5. Biomass energy utilization technologies: direct combustion.

Topic 2.6: Biomass energy technologies: production and use of biogas.

Topic 2.7. Biomass energy utilization technologies: production and use of generator gas.

Topic 2.8. Technologies for the use of geothermal energy.

Topic 2.9. Technologies of coalbed methane utilization.

Topic 2.10: Technologies for the use of excess gas pressure.

Topic 2.11: Technologies for the use of energy from oceans and seas.

Topic 2.12: Technology of using the temperature gradient (heat of the soil, water).

Chapter 3. Technologies for the use of promising energy sources

Topic 3.1: Technologies for the use of nuclear energy and spontaneous chemical reactions.

Topic 3.2. Promising technologies for energy conversion (cosmic radiation, atmospheric electric current, earth magnetism).

Chapter 4. Energy saving and comparison of energy source technologies

Topic 4.1: Comparative analysis of technologies for generating electricity and heat from traditional and non-traditional and renewable energy sources.

Topic 4.2. Energy saving as a "technology" for reducing energy consumption.

4. Training materials and resources

Basic literature:

1. Maczulak, Anne Elizabeth. Renewable Energy: Sources and Methods. United States, Facts On File, 2010.

2. Renewable Energy and Green Technology: Principles and Practices. United States, CRC Press, 2021.

4. Tiwari, G. N., and Mishra, Rajeev Kumar. Advanced Renewable Energy Sources. United Kingdom, RSC Publishing, 2012.

5. Biomass as Raw Material for the Production of Biofuels and Chemicals. Netherlands,CRC Press, 2021.

Supporting literature:

1. Focus on Renewable Energy Sources. United States, Nova Science Publishers Incorporated, 2018.
2. Rathore, Narendra Singh, and Panwar, N. L.. Renewable Energy Sources for Sustainable Development. India, New India Publishing Agency, 2007..

Information resources:

1. Electronic resource. Access mode: https://www.rystadenergy.com/news/total-recoverable-oil-worldwide-is-now-9-lower-than-last-year-threatening-global.

2. Electronic resource. Access mode: https://www.bp.com/content/dam/bp/business-sites/en/global/corporate/pdfs/energy-economics/statistical-review/bp-stats-review-2022-full-report.pdf.

3. Electronic resource. Access mode: https://www.britannica.com/biography/David-Alfred-Thomas-1st-Viscount-Rhondda

6. National Report on the State of the Environment in Ukraine in 2020. Electronic resource. Access mode: https://mepr.gov.ua/files/docs/Zvit/2022/%D0%9D%D0%B0%D1%86%D1%96%D0%BE%D0%BD%D0%B0%D0%BB%D1%8C%D0%BD%D0%B0%20%D0%94%D0%BE%D0%BF%D0%BE%D0%B2%D1%96%D0%B4%D1%8C%202020 %20(2).pdf

Educational content

5. Methods of mastering the discipline (educational component)

During the training, the following strategies are used: active and collective learning; personality-oriented developmental technologies based on active forms and methods of teaching, independent work and independent study of individual topics of the discipline.

Lecture classes

№ s/n	Lecture topics
1	Classification. The potential of energy resources in the world and Ukraine. Basic terminology. *References: [1,2,3,4]*
2	Basic industrial technologies for generating electricity. Development and current state of technologies for the use of unconventional and renewable energy sources. *References: [1,2,3,4]*
3	The potential of water energy. Traditional ways of using water energy. Design of hydraulic units. Modern and advanced technologies. *Literature: [1,2]*
4	Wind energy potential. Traditional ways of using wind energy. Design of wind turbines. Modern and advanced technologies. *Literature: [1,2]*
5	The potential of of solar energy potential. Traditional ways of using solar energy. Design of solar collectors. Modern and advanced technologies. *Literature: [1,2]*
6	Traditional methods of converting solar energy. Design of solar panels and power plants. Modern and advanced technologies. *Literature: [1,2]*
7	The potential of biomass energy. Traditional ways of using biomass energy. Design features of the plants.Modern and advanced technologies. *Literature: [1,2]*
8	Ways to produce and use biogas. Design of bioreactors and biogas plants. Modern and advanced technologies. *Literature: [1,2]*
9	Methods of obtaining and using generator gas. Design features of thermoreactors. *Literature: [1,2]*
10	The potential of geothermal energy. Ways of using geothermal energy. Design of power plants. *Literature: [1,2]*
11	Energy potential of coalbed methane. Ways and means of its use. Cogeneration units for operation on coal mine methane.*Literature: [1,2]*

12	The potential of gas overpressure energy in various industries.Methods and means of its use - detonation units. *Literature: [1,2]*
13	The energy potential of the oceans and seas. Ways and means of utilizing wave and tidal energy - wave and tidal power plants. Promising technologies based on the use of the water salinity gradient. *Literature: [1,2]*
14	Energy potential of soil and water Ways and means of its use - heat pumps. Promising technologies. *Literature: [1,2]*
15	Energy potential of artificial nuclear synthesis and natural nuclear decay.Ways and means of its use. *Literature: [1,2]*
16	The potential of energy of cosmic radiation, atmospheric electric current, and earth magnetism. The ways and means of its use are heat pumps. *Literature: [1,2]*
17	Economic and environmental indicators and characteristics of technologies for generating electricityand heat from traditional and non-traditional and renewable energy sources. Specific indicators. Trends. *Literature: [1,2]*
18	Energy saving potential in energy production and consumption. Modern energy production technologies as a means of energy saving. Promising technologies. *Literature: [1,2]*

Practical classes

Name of the practical work	Quantity. aud. Hours
Case study 1: Assessment of the energy potential of non-conventional energy sources in Ukraine.	2
Practical work 2. Calculation of parameters of a tower-type solar power plant.	2
Practical work 3. Calculation of the kinetic energy of the wind flow.	2
Practical work 4. Calculation of the operating costs of a wind and diesel plant.	2
Practical work 5. Calculation of biogas generators.	2
Practical work 6. Calculation of the energy potential of tidal energy in the ocean basin.	2
Practical work 7. Calculating the capacity of a geothermal power plant.	2
Practical work 8 . Modular control work	2
Practical work 9. Credit	2

6. Independent work of the student

The student's independent work involves:preparation for classroom classes – 56 hours;

modular control work 4 hours;

The credit period is 6 hours.

Policy and control

7. Policy of the academic discipline (educational component)

At the time of each lesson, both lecture and practical, the student must have the Zoom application installed on the device he or she is working from (in the case of distance learning), and also the course "Technology of Energy Production from Traditional Raw Materials and in Alternative Energy Sources" on the Sikorsky platform (the course access code is provided at the first lesson according to the schedule).

The silabus, lecture material, assignments for each practical lesson, variants of the module test, and guidelines for practical classes are available on the «Sikorsky» platform and in the «KPI Electronic Campus system».

During the course, students are obliged to adhere to the general moral principles and rules of ethical behavior specified in the Honor Code of the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute".

All students, without exception, are obliged to comply with the requirements of the Regulations on the system of preventing academic plagiarism at the National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute".

5. Types of control and rating system for assessing learning outcomes (RSO)

Current control:

The student's rating for a credit module is calculated from 100 points, namely:

- execution and defense : 9 points x 7 = 63 points,
- completion of a module test with 37 points.

The assignments in the **practical class are** worth 9 points based on the following criteria:

- "excellent" - a complete answer (at least 90% of the required information) - 9-8 points;
- "good" - a sufficiently complete answer (at least 75% of the required information), which is performed in accordance with the requirements for the "skill" level or contains minor inaccuracies - 8 - 7points;
- "satisfactory" - an incomplete answer (at least 60% of the required information), performed in accordance with the requirements for the "stereotypical" level and containing some errors - 6 points;
- "unsatisfactory" - an unsatisfactory answer is less than 5 points.

The module test is performed at the end of the semester and is evaluated with 37 points accordingto the following criteria:

- "excellent" - a complete answer (at least 90% of the required information), a draft task withcorrect answers - 33 - 37 points;
- "good" - a sufficiently complete answer (at least 75% of the required information), the developed draft assignment contains minor inaccuracies - 28 - 32 points;
- "satisfactory" - an incomplete answer (at least 60% of the required information), the developeddraft task contains some errors - 22-27 points;
- "unsatisfactory" - an unsatisfactory answer is less than 18 points.

Calendar control: is conducted twice a semester as a monitoring of the current state of fulfillment of the requirements of the sila-bus. The condition for a positive first and second calendar control is to obtain at least 50% of the maximum possible rating at the time of the relevant calendar control.

Semester control: credit.

The rating scale for the discipline is R=9*7+37*1=100 points

Table of correspondence between rating points and grades on the university scale:

Number of points	*Assessment.*
100-95	Excellent
94-85	Very good
84-75	Okay.
74-65	Satisfactory
64-60	Enough
Less than 60	Unsatisfactory
The conditions for admission are not met	Not allowed

9. Additional information on the discipline (educational component)

The list of questions to be submitted for semester control is given in the appendix to the syllabus

Work program of the discipline (syllabus):Compiled by Professor Mazurenko L.I.
Approved by the Department of AEMC (Protocol No. 17 of 31.05.2023)

Approved by the Methodological Commission of the Institute of IEE (Minutes No. 9 of 22.06.2023).

Theoretical questions for the test in the discipline "Technology of energy production from traditional rawmaterials and alternative energy sources"

1. World classification of energy resources.
2. Possible ways to improve the world energy sector.
3. General characteristics of oil, gas and coal reserves in the world as of the beginning of 2021.
4. Basic industrial technologies for generating electricity.
5. Production of thermal and electrical energy using cogeneration technology.
6. Traditional ways of using water energy.
7. Modern and promising technologies for the use of water energy.
8. Traditional ways of using wind energy.
9. Construction of wind turbines.
10. Traditional ways of using solar energy.
11. Design of solar collectors.
12. Design of solar panels and power plants.
13. Modern and advanced solar energy conversion technologies.
14. Traditional ways of using biomass energy.
15. Design features of biomass energy plants.
16. Methods of obtaining and using biogas.
17. Design of bioreactors and biogas plants.
18. Methods of obtaining and using generator gas.
19. Energy potential of coalbed methane.
20. Ways and means of using coal mine methane.
21. The potential of geothermal energy.
22. Design of a geothermal power plant.

23. Process flow diagram of a turboexpander unit.
24. Utilization of wave and tidal energy.
25. Operation of a tidal power plant.
26. Energy of water salinity.
27. Heat pumps.
28. Thermonuclear energy.
29. Hydrogen energy.
30. Fuel cells.
31. Cosmic radiation.
32. Ecological and economic efficiency of non-conventional energy sources.
33. The cost of 1 kWh of electricity for different types of power plants.
34. Energy saving potential in electricity production and consumption.