Syllabus
Course Program

Power Supply Systems

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,
Electrical Power Engineering. Energy Management and Energy-Efficient Technologies

Department
Electric Power Stations (130)

Level of education
Bachelor's level

Course type
Special (professional), Optional

Semester
8

Language of instruction
English, Ukrainian

Lecturers and course developers

Shokarov Dmytro

Dmytro.Shokarov@khpi.edu.ua
PhD, Associate Professor, Associate Professor of the Department Electric Power Stations

Author of more than 90 scientific, educational, and methodological publications. Leading lecturer of the disciplines: " Power Plant Dispatching and SCADA", " Electrical Part Of Stations And Substations ", " Power Supply Systems".
More about the lecturer on the department's website

General information

Summary

The " Power Supply Systems " course formation of the necessary knowledge and skills in the field of the use of electrical energy in various technological processes, familiarization with the problems of production and use of electrical energy; study of sources of electricity in the power supply systems of enterprises; study of potential energy saving opportunities; energy-saving modes in power supply systems, familiarization with the organization of work in power systems to reduce power losses and problems of power accounting.

Course objectives and goals

Goal.
Training of students in the field of dispatch control and SCADA systems of power plants.
Objectives.
To know:
- basics of designing power supply systems;
-basic rules for designing power supply systems of enterprises;

- sources of losses in the production, supply and use of electricity; means of saving and quality parameters of electricity;
- sources of reactive power and existing means of its compensation;
- rules of organization and principles of construction of means of accounting for electricity consumption;
To be able to:
- choose and calculate external and internal power supply schemes for industrial enterprises;
- identify sources of losses and calculate their values; determine the main parameters of electricity quality;
-to organize electricity accounting of industrial enterprises.

Format of classes

Lectures, practical studies, consultations, self-study. Final control – exam.

Competencies

GC 7. Skills of using information and communication technologies.
GC 9. Ability to search, process and analyze information from various sources
PC 1. Ability to use computer-aided design (CAD), manufacturing (CAM) and engineering calculations (CAE) and related application software packages.
PC 21. Receipt and use of professional knowledge and understanding related to the information protection of power systems with the use of modern information and computer technologies.

Learning outcomes

PRT 1. To find the necessary information in the information space.
PRT 30. To improve the skills of working with modern equipment and software when performing calculations of operating modes of electrical, electrical and electromechanical equipment, corresponding complexes and systems

Student workload

The total volume of the course is 120 hours (6 ECTS credits): lectures - 30 hours, practical classes (workshops) – 20 hours, self-study - 70 hours.

Course prerequisites

Electrical Part Of Power Stations And Substations, Electrical Part. Electrical Systems and Networks

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

Lectures are conducted interactively using multimedia technologies. At workshops and laboratory classes, the skills of student work formatting, the ability to use the university educational platform and resources are practiced. Practical tasks are performed using open-source software or on the Microsoft 365 platform. Learning materials are available to students through the OneNote Class Notebook.

Program of the course

Topics of the lectures

Objectives of the discipline
The value of this discipline for other professional disciplines. The amount of educational material, types of classes and organization of training.

Content module 1. SCADA system
Topic 1 GENERAL
Standards and Codes. Power Supply Design Criteria Electrical Power Systems. Design Procedures. Evaluation and Selection of Energy Systems. Design Analysis. Service Conditions. Explanation of Abbreviations and Terms.

Topic 2 ELECTRICAL POWER REQUIREMENTS

General. Load Estimation.

Topic 3 VOLTAGE SELECTION

System Voltage Classifications. Selection of Primary Distribution Voltage for New Installations. Selection of Primary Distribution Voltage for Existing Installations. Commercial Power for Air Force Installations. Selection of Primary Distribution Voltage for Air Force Installations.

Topic 4 MAIN ELECTRIC SUPPLY STATIONS/SUBSTATIONS

System Voltage Classifications. Station Designation and Elements. Main Electric Supply Station/Substation. Environmental Aspects. Incoming Line Switching Equipment. Substation Equipment. Miscellaneous Station Design Criteria. Substation Equipment at Air Force Installations.

Topic 5 ELECTRIC DISTRIBUTION LINES

Selection. Types of Underground Lines. Types of Underground Lines. Types of Aerial Lines. Voltage Drop. Power Factor Correction. Medium-Voltage Circuits. Pad-Mounted Line Sectionalizing Equipment. Joint Electrical/Communication Lines for Air Force Installation.

Content module 2. Energy management systems

Topic 6 AERIAL DISTRIBUTION LINES

Installation Considerations. Conductors. Poles. Circuit Configurations. Insulators Guying. Miscellaneous Items. Air Force Installations.

Topic 7 UNDERGROUND DISTRIBUTION LINES

Cable Duct Lines. Manholes, Handholes, and Pullboxes. Direct-Burial Cable Installations.

Topic 8 TRANSFORMER INSTALLATIONS

Distribution-to-Utilization Voltage Transformers. Installation of Transmission-to-Distribution Voltage Transformers. Transformer Dielectrics. Transformer Characteristics. Amorphous Metal-Core Transformers. Transformers at Air Force Installations.

Topic 9 SURGE PROTECTION AND GROUNDING

Voltage Surges and Potential Gradients . Methods of Controlling Voltage Surges and Potential Gradients. Ground Electrodes.

Topic 10 ROADWAY AND AREA LIGHTING

Roadway Lighting Design. Area Lighting Design. Walkway and Bikeway Lighting Design. Light Sources. Lighting Control and Wiring System

Topics of the workshops

Topic 1. Calculation of electrical loads. Methods of calculating electrical loads (2 hours).
Topic 2. Calculation of power electrical loads in electrical networks above 1000 V (2 hours).
Topic 3. Selection of schemes and calculation of external power supply of the enterprise (2 hours).
Topic 4. Construction of a cartogram of electrical loads and selection of the location of the main step-down substation (2 hours).
Topic 5. Calculation of short-circuit currents in power supply systems of industrial enterprises (2 hours).
Topic6. Selection of 10 kV cables for the plant's high-voltage network. Selection of high-voltage electrical devices (2 hours).
Topic 7. Calculation of reactive power balance and selection of compensating devices in high-voltage and low-voltage networks (2 hours).
Topic 8. Calculation of parameters of the quality of electrical energy (2 hours).
Topic 9. Quality of electrical energy in the power supply system. Indicators of the quality of electric energy (2 hours).
Topic 10. Calculation of the actual power factor and the charge for the consumption of reactive energy (2 hours).

Topics of the laboratory classes

Laboratory work is not provided

Self-study

The educational component of "Electricity supply system" involves the performance of calculation work (C). The results of calculations are drawn up in a written report.
Topic C: "Calculation of the shop's power supply system."
The explanatory note should include the following sections:
1. Compilation of the shop's power supply scheme.
2. Determination of the calculated load of groups of electric receivers and on TP tires.
3. Determination of the number, power and type of power transformers taking into account reactive power compensation. Justification of the workshop TP scheme.
4. Selection of electrical equipment of the shop's power supply system.
5. Calculation of short-circuit currents in the shop's distribution network.
6. Selection of devices for protection of elements of the shop's distribution network.
7. Used literature.

Coursework

The educational component of "Electricity supply system" involves the performance of calculation work (C). The results of calculations are drawn up in a written report.
The term of defense of the coursework is the 16th week.

Course materials and recommended reading

Compulsory.
1. EPRI-RP3098-01, An Assessment of Distribution System Power Quality.
2. A. McEachern, “Roles of Intelligent Systems in Power Quality Monitoring: Past, Present, and Future,” Conference Record, Power Engineering Society Summer Meeting, 2001, Vol. 2, pp. 1103–1105.
3. R. P. Bingham, “Recent Advancements in Monitoring the Quality of the Supply,” Power Engineering Society Summer Meeting, 2001, Vol. 2, pp. 1106–1109.
4. Dranetz Engineering Laboratories, “Series 606 Power-Line Disturbance Analyzer,” December 1975.
5. E. W. Gunther, J. Rossman, “Application of Advanced Characterization Algorithms, UCA and Internet Communications Technology at the Point of Power Quantity and Quality Measurement,” Conference Proceedings of EPRI PQA 1999.
6. IEEE Standard 141-1993: Recommended Practice for Power Distribution in

Industrial Plants.
7. IEEE Standard 519-1992: Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
520 Chapter Eleven
Power Quality Monitoring

8. IEC 61000-4-15, Electromagnetic Compatibility (EMC). Part 4: Testing and Measuring Techniques. Section 15: Flickermeter—Functional and Design Specifications.
9. D. A. Douglass, Potential Transformer Accuracy at 60-Hz Voltages above and below Rating and at Frequencies above 60 Hz. Presented at the IEEE Power Engineering Society Summer Meeting, Minneapolis, Minn., July 13–18, 1980.
10. D. A. Douglass, "Current Transformer Accuracy with Asymmetric and High Frequency Fault Currents," IEEE Transactions on Power Apparatus on Systems, Vol. PAS-100, No. 3, March 1981.
for the Exchange of Power Quality
Measurement and Simulation Data, SCC 22.

Additional.
1. S. Santoso, J. D. Lamoree, "Answer Module: A Custom-Built Module to Meet Specific Power Monitoring Tasks," Conference Proceedings of EPRI PQA 2001, Pittsburgh, Pa.
2. U. Fayyad, G. Piatetsky-Shapiro, P. Smyth, "From Data Mining to Knowledge Discovery: An Overview," in U. Fayyad, G. Piatetsky-Shapiro, P. Smyth, R. Uthurusamy, eds., Advances in Knowledge Discovery and Data Mining, MIT Press, 1996, pp. 471–494.
3. S. Santoso, R. C. Dugan, J. D. Lamoree, A. Sundaram, "Distance Estimation Technique for Single Line-to-Ground Faults in a Radial Distribution System," Conference Record, Power Engineering Society Winter Meeting, 2000 IEEE, Vol. 4, pp. 2551–2555.
4. S. Santoso, J. D. Lamoree, M. F. McGranaghan, "Signature Analysis to Track Capacitor Switching Performance," Conference Record, Transmission and Distribution Conference and Exposition, 2001 IEEE/PES, Vol. 1, pp. 259–263.
5. IEEE Standard 1159-1995, Recommended Practice on Monitoring Electric Power.
6. Draft Standard IEC 61000-4-30 77A/356/CDV, Power Quality Measurement Methods.
7. IEEE Draft Standard P1159.3, Recommended Practice for a Power Quality Data Interchange Format—An Extensible File Format

Assessment and grading

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

Final score consists of up to:
30 points for two module tests,
30 points for laboratory classes and workshops tasks,
20 points for coursework, and
20 points for final tests.

Coursework defense is mandatory.

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 Oleksandr LAZURENKO