Name of subject	Power supply of power supply systems (ECTS 8)
Subject/module code	ETT24508
Science taught semester (s).	4th and 5th semester
Responsible teacher	Abdullaev Elnur Akhmatovich (PhD), associate professor.
Education language	Uzbek
Study to the program connection	Elective
Training hours (this including independent education)	**Total hours-240.** **Audience Training hours - 120.** Lecture training hour – 48 Laboratory training hour – 24 Practical training hour – 24 **Independent education -144 hours**
ECTS	8
The purpose and tasks of subject / learning outcomes	**The purpose of teaching the subject** is to teach students the parameters and conditions of electrical networks, master the methods of calculating and analyzing the conditions of Power supply of power supply systems, teach the basics of designing the development of electrical systems, teach measures to increase the economy of electrical networks, and familiarize them with the structural and mechanical parts of overhead power lines and teach the basics of their calculation. **The task of the subject** is to teach students how to construct switching schemes for elements of electrical networks and determine their parameters, calculate the electrical states of open and closed electrical networks of varying complexity, characterize the operating states of Power supply of power supply systems and their assessment, control and adjustment in Power supply of power supply systems; design electrical networks, and the main criteria for improving and ensuring the efficiency of electrical networks. **Learning outcomes:** 1. Study the history and prospects of the development of the electric power system. 2. Get acquainted with the role and socio-economic significance of electric power in society. 3. Study the state policy of the energy sector and its development trends and prospects in the country and the world. 4. Study the basic concepts and principles in the field of energy networks and systems. 5. Economic assessment of the competitiveness of traditional and unconventional methods of electricity generation. 6. Get a complete picture of the equipment and devices of electric networks and systems. 7. Gain knowledge and skills in the design of electric networks.
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions)** **Topic 1:** Goals and objectives of science. System of accepted basic definitions. The role of energy networks and systems in the transition of the Republic of Uzbekistan to a "green" economy **Topic 2:** Structure of power lines. General information about overhead lines. Wires and cables of overhead lines. Supports of overhead lines. Function of all-important equipment in power distribution networks. **Topic 3:** Insulators and line fittings. Cable structure and cable lines. **Topic 4:** Switching schemes and calculation parameters of power transmission lines. Determination of comparative parameters of power transmission lines. Estimation and modeling of parameters **Topic 5:** Two-winding transformer replacement diagram, catalog and

	calculation parameters **Topic 6:** Three-winding transformer switching diagram, catalog and calculation parameters. Autotransformer switching diagram, catalog and calculation parameters. Characteristic characteristics of the autotransformer. Nominal and type capacities of the autotransformer. **Topic 7:** Consumer loads. Static characteristics of consumer loads. Categories of consumers. Basic aspects of design and measurement of electrical systems **Topic 8**. Calculation of the state of the power transmission line given the load current and voltage. Vector diagram of the power transmission line current and voltage. Simplified methods for calculating voltage **Topic 9:** Calculation of the electricity transmission network state when the load power and voltage are given. Calculation of the electricity transmission network state when the load power and source voltage are given. Two-stage method. Calculation of the open network states consisting of several electricity transmission networks connected in series and with known load powers. **Topic 10:** Three-winding transformers. Switching diagram and its parameters. Transformers with separate windings. **Topic 11:** Calculation of power flows in simple closed electrical networks with and without losses. **Topic 12:** Calculation of power and voltage distribution in networks supplied from both sides. Calculation of power flows in networks supplied from both sides, taking into account losses. Calculation of voltage distribution in networks supplied from both sides. **Topic 13:** The importance of ensuring active power balance in the electrical system. Frequency deviation and oscillation in the electrical system. Permissible frequency deviation value. Frequency adjustment in turbines. Automatic frequency unloader. Frequency adjustment in the electrical system. **Topic 14:** Reactive power balance in the electrical system and its relationship to voltage. Load balancing effect. Reactive power consumers. Ensuring reactive power balance in network design. **Topic 15:** Tasks of reactive power compensation in the electrical network. The effect of reactive power compensation on energy and voltage losses. Reactive power compensators**.** **Topic 16:** Application of a systems approach and optimization in reactive power compensation. Advantages and disadvantages of a capacitor bank as a compensator. Reactive power generated by a capacitor bank. Advantages and disadvantages of reactors as compensators. Static sources of reactive power**.** **Topic 17:** Quality indicators of electric energy. Normalized values of voltage deviation. The impact of quality indicators of electric energy on the effective operation of the network and consumers. Technological damage caused by violations of quality indicators of electric energy. **Topic 18:** Three-winding transformer switching diagram, catalog and calculation parameters. Autotransformer switching diagram, catalog and calculation parameters. Characteristic characteristics of the autotransformer. Nominal and type capacities of the autotransformer. **Topic 19:** Voltage stabilization, single-phase and multi-phase regulation. Local and centralized voltage regulation. Reverse voltage regulation. Voltage regulation in power plants. **Topic 20:** Voltage regulation using a automatic adjustment of the excitation transformer. Voltage regulation using a adjust under load transformer. Schemes and principles of operation of automatic adjustment of the excitation and adjust under load devices. Voltage regulation using line rectifier transformers. **Topic 21:** Adjusting the voltage by changing the network resistance.

Determining the resistance of the longitudinal compensation device required to adjust the voltage. Adjusting the voltage by changing the reactive power flow.

Topic 22: Methods of designing an electric network. Main technical and economic indicators. Issues of designing the development of an electric network. Main technical and economic indicators. Selection of the nominal voltage of an electric network.

Topic 23: Compare electricity network options in terms of capital investment and additional costs. Compare electricity network options in terms of costs incurred. Consider the level of reliability when comparing options. Select the nominal voltage when designing an electricity network.

Topic 24: Selection of cross-sectional areas of conductors according to economic current density. The concept of economic current density. Advantages and disadvantages of the method.

II. Instructions and recommendations for organizing laboratory exercises.

In laboratory exercises, students develop practical skills and competencies in various indicators of processes in Power supply of power supply systems, conducting experiments, calculating and drawing tables and graphs. The recommended topics are selected based on opportunities and conditions.

Recommended topics for laboratory work:

1. Study of normal states of an electrical system. Creation of models for electrical equipment.
2. Study of operating conditions of long power lines.
3. Calculation of the normal state of an electrical network using the Gauss-Seidel method.
4. Calculation of the normal state of an electrical network using the Newton-Raphson method.
5. Reactive power compensation in electrical networks
6. Adjusting voltage in electrical networks by changing the transformation coefficient of transformers
7. Adjusting voltage in electrical networks by changing the resistance of the electrical network.
8. Adjusting the voltage in electrical networks by changing the reactive power of the electrical network.
9. Reducing waste in electrical networks.
10. Increasing the efficiency of electrical network operations.

III. Practical training instructions and recommendations

The teacher's preparation for a practical training session begins with the study of preliminary documents (curriculum, thematic plan, etc.) and ends with the development of a lesson plan. The teacher should have an idea of the goals and objectives of the practical training session, the amount of work that each student must perform.

Methodological guidelines are the main methodological document of the teacher in preparing and conducting practical training sessions.

The purpose of the practical training session is to understand the theory, acquire skills. It is to consciously apply it in educational and professional activities, and to develop the ability to confidently form one's own point of view.

The following topics are recommended for practical training:

1. Construction of equivalent circuit diagrams of electricity transmission network and two-winding transformers and finding calculation parameters.
2. Construct equivalent circuit diagrams of three-phase transformers and autotransformers and find calculation parameters.
3. Calculation of open electrical network conditions

	4. Calculation of the electricity transmission network state with known load power (current) and voltage at the end. Calculation of the electricity transmission network state with known load power (current) and voltage at the beginning. 5. Calculation of open electrical network conditions with known load capacities and voltage at the supply node. 6. Voltage regulation at step-down substations. 7. Choosing the nominal voltage of the electrical network. 8. Selection of the cross-section of the electricity transmission network conductor based on economic current density, economic intervals, and permissible voltage modes. 9. Calculation of power and energy waste in electricity transmission network. 10. Calculation of power and energy losses in the line based on the load graph. 11. Determining power and energy losses in a transformer based on load graphs. 12. Measures to reduce power and energy waste in electrical networks. **IV. Independent learning and independent work.** Independent learning competence serves to support students' independent self-development and increase the effectiveness of professional activities. Students perform independent work on their mobile devices under the guidance of a teacher in a traditional or electronic form. **Recommended topics for independent study:** 1. Calculation and analysis of highly complex electrical network conditions. 2. Circular vector diagrams of power transmission line parameters. 3. Calculation of the distribution of power flows in homogeneous closed electrical networks by dividing them into circuits. 4. Electrical load graphs. 5. Construction of equivalent circuit diagrams of EUL and transformers and finding calculation parameters. 6. Calculation of electrical network conditions. 7. Simple and complicated substances and importance. 8. Power and energy waste in electrical networks. 9. Reactive power compensation in electrical networks. 10. Selection of power line conductors. 11. Modeling operating conditions of electrical networks using computer programs, developing practical skills.
Student assessment	Assessment of student knowledge is based on the mastery of the learning material during the semester and final control (tests, assignments, written and oral work results). During the course of Power supply of power supply systems, students are evaluated on a 100-point system. Of these, 50 points are allocated to the current and intermediate results (60% of 50 points are current control, independent study and 40% are intermediate control), and 50 points are allocated to the final control results. Students whose total score of current and intermediate points is less than 30 points are not admitted to the final control exam. A student who scores 30 or more points in the final control is considered to have mastered the subject.
Requirements for exams	The student must have fully mastered the theoretical and practical concepts of the subject, be able to correctly reflect the results of the analysis. The student must have completed the tasks given in the current and intermediate forms of independent work, assessment. At the same time, he must have received the necessary points from the current, intermediate, independent education and final tests in the relevant subject within the specified time.

	A student who has not submitted current control, intermediate control and independent education tasks, as well as who has scored less than 30 points on these tasks and types of control, will not be included in the final type of control. Also, a student who has missed 25 or more percent of the classroom hours allocated to the subject without an excuse will be expelled from this subject, will not be allowed to take the final exam and will be considered as not having mastered the relevant credits in this subject. A student who fails the final exam or scores less than 30 points on this type of exam is considered academically indebted.
Recommended Literature	**Main literature:** 1. Elektr tarmoqlari va tizimlari: O‘quv qo‘llanma/ A.M. Safarov, T.Sh. G‘oyibov, A.X. Sulliyev. O‘zbekiston Respublakasi Oliy va o‘rta maxsus ta’lim vazirligi. Toshkent. Tafakkur bo‘stoni. 2013.-224 b. 2. Gayibov T.Sh. Elektr tarmoqlari va tizimlari. O‘quv qo‘llanma. – T.: «Voris-nashriyot». 2010. 3. T.Sh. Gayibov., B.M. Pulatov., A.E. Shanazarov. “Elektr tarmoqlari va tizimlari. Misol va masalalar to‘plami”. O‘quv qo‘llanma. –Toshkent., ToshDTU, 2021-175 b. 4. T.Sh. Gayibov, H.F. Shamsutdinov, B.M. Pulatov Elektr tarmoqlari va tizimlari fanidan kurs loyihasini bajarish uchun uslubiy qo‘llanma. – Toshkent: ToshDTU, 2015-57 b. 5. Electric Power Systems/ B.M.Weedy, B.J.Cory, N.Jenkins, J.B.Ekanayake, G.Strbac.- 5th ed., UK, A John Wiley and Sons, 2012. 6. Duncan Glover, Mulucutla s. Sarma, Thomas J. Overbye. Power System Analysis and Design/Fifth edetion.- Australia, Brazil, Japan, United Kingdom, USA. CANGAGE Learning. 2010. 7. Arthur R. Bergen/ Power Systems Analysis / 2000. 8. Elektr tarmoqlari va sistemalari: uslubiy qo‘llanma/ O‘zR OO‘MTV; Rasulov A.N., Taslimov A.D., Mamarasulova F.S., Raxmonov I.U.– Toshkent: TDTU, 2014.- 90 b. **Additional literature:** 9. Mirziyoyev Sh.M. Yangi O‘zbekistonda erkin va farovon yashaylik. –T.: “TASVIR nashriyot uyi”, – 2021.– 50 b. 10. Mirziyoyev Sh.M. Milliy taraqqiyot yo‘limizni qati’yat bilan davom ettirib yangi bosqichga ko‘taramiz .–T.:“O‘zbekiston”, 2017–592 b 3. Decree of the President of the Republic of Uzbekistan dated January 28, 2022 No. PF-60 “On the Development Strategy of New Uzbekistan for 2022-2026”. 4. Decree of the President of the Republic of Uzbekistan No. PF-220 dated 09.09.2022 “On additional measures for the introduction of energy-saving technologies and the development of small-capacity renewable energy sources”. 13. Лыпкин А.В. Электрические системы и сети (Электронный ресурс): (учеб. пособ.)– Новосибирск: Изд-во НГТУ, 2002.-248 с 14. Электрические системы и сети. Буслова Н.В., Винославский В.Н., Данисенко Т.И., Перхач В.С. Под ред. Данисенко Г. – Киев: Высшая школа, 2006. 15. Блок В.М. Электрические сети и системы. Высшая школа, 2006. **Internet resources:** 16. www.lex.uz – National database of information on legal documents of the Republic of Uzbekistan. 17. www.ziyonet.uz – national educational materials search site. 18. www.gov.uz – Government portal of the Republic of Uzbekistan. 19. www.google.com – international educational materials search site.

	20. www.energystrategy.ru – “Energy Policy and Strategy” information portal 21. www.twirpx.com – international educational materials search site.