Name of subject	Urban electricity supply (ECTS 9)
Subject/module code	SHET16709
Science taught semester (s).	6th and 7th semester
Responsible teacher	Boliev Alisher Mardievich, assistant.
Education language	Uzbek
Connection to the curriculum	Compulsory
Training hours (this including independent education)	**Total hours-270.** **Audience Training hours - 108.** Lecture training hour – 60 Laboratory training hour – 24 Practical training hour – 24 **Independent education -162 hours**
ECTS	9
The purpose and tasks of subject / learning outcomes	**The purpose of teaching science** This program on the subject of "Urban Electricity Supply" is based on the established state educational standard and qualification requirements and the approved subject program. In our republic, great attention is paid to the training of qualified energy specialists in the context of further deepening economic reforms and the development of market relations. This program includes information about electricity consumers, electrical equipment and base substations, urban electrical equipment, and lighting in the urban power supply system. This subject includes information about electricity consumers, electrical equipment and base substations, urban electrical equipment, and lighting in the urban power supply system. **The task of subject** is to teach the basics of urban power supply, their schemes, methods for optimizing the operation of electricity consumers. To teach urban power supply schemes and familiarize with the electrical systems of cities. Lectures on topics in the theoretical part are structured in accordance with the content of the module. To achieve this goal, the subject performs the tasks of providing students with theoretical knowledge, practical skills, a methodological approach to phenomena and processes, and the formation of a scientific worldview. **Learning outcomes:** 1. The introductory course on urban power supply studies the development, history and prospects of the electric power system. 2. The role and socio-economic significance of electricity in society. 3. State policy in the energy sector and its development trends and prospects in the country and the world. 4. Basic concepts in the electric power sector. 5. Main performance indicators for various types of transport and opportunities for their improvement. 6. Improving the efficiency of electric power generation equipment. 7. Economic assessment of the competitiveness of traditional and unconventional methods of electric power generation.
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions)** **Topic 1:** Introduction Information about the city's electricity supply system and consumers. The role of the city electricity supply industry 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:** Brief description of cities. Classification of cities and settlements by population. Social and

communal facilities in the largest and largest cities. Zones of the territory of the settlement. Common electrical receivers and electrical consumers in houses. Household appliances. Cultural and household appliances. Sanitary and hygienic equipment. Common electrical consumers in houses.

Topic 4: Reliability of urban electricity consumers

Requirements for the reliability of electricity supply to residential and public buildings. Grouping of urban electricity consumers by reliability. General information about elevator installations. Complex of buildings and structures in the city.

Topic 5: Determining electrical loads in the city's power supply system.

Topic 6: City electrical loads and consumption. Calculation of electrical loads. All groups of city electrical energy consumers. Load graphs of city electrical networks and consumers. Estimated electrical load of residential electrical energy consumers. Estimated load on the line or TP bus.

Topic 7: Determination of design loads of residential and public buildings. Electrical energy receivers of residential and public buildings. Design load of residential and public buildings. Determination of design loads of residential buildings. Determination of design loads of public buildings.

Topic 8: Schemes of supply and distribution power networks.

Schemes of supply power networks. Rules for developing supply power network schemes in large cities. Schemes of distribution power networks. Radial and trunk power network schemes. Schemes of external power supply of residential and public buildings.

Topic 9: Internal power supply schemes. Input distribution devices and schemes. Basic schemes of residential electrical networks. Structural scheme of the electrical network of buildings. Internal schemes of execution of urban electrical networks and requirements for them.

Topic 10: Voltage selection in the urban power supply system

Establishment of a standard voltage scale. Nominal voltages of electrical networks, consumers and alternating current sources. Nominal phase voltages of three-phase current and the highest operating voltage above them.

Topic 11: Basic rules for selecting power transmission line voltage. Basic rules to consider when selecting power transmission line voltage. The task of selecting voltage in a power supply system. Selecting the optimal voltage value.

Topic 12: Voltage selection in distribution networks Selection of nominal voltage for supply power networks. Selection of nominal voltage for distribution power networks. Costs involved in voltage selection. Selection of optimal voltage for a 10 kV power network. Selection of optimal voltage for an internal power network up to 1 kV.

Topic 13: Selection of cable lines in the city power supply system**.**

Topic 14: General characteristics of cables, cables and their types. Underground and overhead cable lines. Low-pressure oil cables of various brands. Parameters of oil-filled high-pressure cables. Technical and economic indicators of cables. Capital costs for cables, operating costs. Level of power loss in cable lines.

Topic 15: Cable lines with voltages of 35-110-220 kV

Cable lines with voltages of 35 kV and their application. Cable lines with voltages of 110 kV and their application. Cable lines with voltages of 220 kV and recommendations for their application. Advantages and disadvantages of high-voltage cables. Location and dimensions of cables in trays.

Topic 16: Selection of the cross-sectional area of cables for power networks with voltages up to 1 kV and 6-10 kV. Cable lines for power

networks with voltages up to 1000 V. Cable lines with voltages of 6-10 kV. Conditions for selecting the cross-sectional area of cable lines. Selection of the cross-sectional area of cable lines according to the economic current density. Selection of cable lines according to the thermal resistance of the short-circuit current.

Topic 17: Transformer substations of the city's power supply system.

Topic 18: Connection of step-down substations to electrical networks. Transformers and substations used in urban electrical networks. Technical and economic indicators of transformers. Types of connection of substations to the network. Typical schemes of substations with different nominal voltages.

Topic 19: Transformer substations with voltages of 35-500/6-10 kV. Technical and economic models of substations. Location and dimensions of substations. Capital costs. Operating costs. General structure of the substation building. Power and energy losses in transformers.

Topic 20: Selection of the number and power of transformers in 10/0.4 kV substations. Transformers in 10/0.4 kV substations. Location of substations in the design of internal networks. Selection of the number and power of transformers in 10/0.4 kV substations in the urban power supply system. Technical data of transformers for complete transformer substations.

Topic 21: Protective devices for residential and public buildings in the city power supply system.

Topic 22: Protective devices for residential and public buildings. Abnormal situations that may occur in the city power supply system. Protective devices for residential and public buildings: fuses and circuit breakers. Control panel diagrams of switching devices used in distribution electrical networks up to 1000 V.

Topic 23: Circuit breakers. Ensuring selectivity in the use of circuit breakers. Circuit breakers in residential and public buildings. Basic circuit breakers. Types of circuit breakers according to operating conditions. Factors affecting selectivity in radial power supply schemes. Network protection with switching and protective devices.

Topic 24: Optimization of urban power supply system parameters**.**

Topic 25: Basic rules for parameter optimization Comparison of network parameters for optimal construction of a city power supply system. Optimization of individual elements of the system. Costs given to minimize capital costs. Annual depreciation rates. Costs given and related coefficients.

Topic 26: Optimization of parameters and analysis of technical and economic indicators. Optimization of parameters of urban electricity supply. Analysis of technical and economic indicators by parameters. Criteria for costs by technical and economic indicators.

Topic 27: Optimization of the urban power supply system

Systematic optimization of the urban power supply system according to network parameters. Optimization according to the length and cross-sectional area of the existing lines in the city. Optimization according to the number of outgoing lines, the number and power of transformer substations.

Topic 28: Optimization and methods of urban power supply parameters.

Topic 29: Accounting and control of electricity in the urban power supply system History of the accounting and control system of electricity. Accounting for electricity consumption in elements of urban power networks. Power and electrical energy waste in power networks. About the history of the accounting and control system of electricity.

Topic 30: Automated system for accounting and control of electricity.

Structural elements of the automated system for accounting and control of electricity in urban power supply. Technical means of the automated system for accounting and control of electricity. Software tools of the automated system for accounting and control of electricity.

II. Instructions and recommendations for organizing laboratory exercises.

During laboratory work, students will develop practical skills in urban power supply schemes, loads, and electricity quality indicators.

Suggested topics for laboratory work:

1. Construction of load charts for urban electricity consumers.
2. Research on urban power supply schemes.
3. Checking non-sinusoidal modes in urban power grids.
4. Study of the procedure for symmetrizing asymmetrical loads of a three-phase network in cities.
5. Study of schemes of step-down substations in cities.
6. Study of protective devices for residential and public buildings in the city power supply system.
7. Study of schemes for automatically connecting a reserve source in urban electrical networks.
8. Selection of cross-sectional area of cables for urban power networks.
9. Parameter optimization and analysis of technical and economic indicators.
10. Accounting and control of electrical energy in the city's power supply system.

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.

Recommended practice topics:

1. Calculation of loads of urban electricity consumers.
2. Selection of urban power supply schemes.
3. Voltage selection for urban power supply systems.
4. Selection of cross-sectional area of cables for urban power networks.
5. Determining the installation location of the BPP and calculating the electrical load map.
6. Selection of the number and capacity of transformers in substations.
7. Calculation of short-circuit currents in the urban power supply system.
8. Selection of protective devices for residential and public buildings in the city power supply system.
9. Optimization of the city's power supply system.
10. Accounting and control of electricity in the city's power supply system.
11. Analyze the role of urban networks in the urban power supply system.
12. Optimization of the urban power supply system and its analysis results.

IV. Instructions and recommendations for coursework.

The coursework develops the skills of creative independent work, forms

	in students the skills of calculating and selecting elements of the power supply system of cities. Each student is given an individual assignment. Approximate topics of the coursework: 1. Electrical loads of urban electricity consumers (residential, commercial and public buildings). 2. Selection of cross-sectional areas of cable lines. 3. Calculation of the location and power of transformer substations. 4. Selection of a power supply scheme for a microdistrict or district. 5. Calculation of short-circuit currents and selection of switching equipment. **V. 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. **Independent study for recommended topics:** 1. Determination of calculated electrical loads in urban networks. 2. Construction of 6-10 kV supply networks. 3. Construction of building electrical network schemes. 4. Electrical network distribution schemes in residential buildings. 5. Internal electrical energy distribution schemes in public buildings. 6. Optimization of parameters of urban electrical networks and analysis of technical and economic indicators. 7. Technical and economic indicators of transformers and small urban substations. 8. Rational distance for transmitting electrical energy at a voltage of 6-10 kV in the urban power supply system. 9. Determination of power and electrical energy waste in urban power networks. 10. Accounting and control of electrical energy in urban power networks. 11. Optimization of the urban power supply system. 12. Selection of the cross-sectional area of cables in urban power networks 13. The current state of accounting and control of electricity in the urban power supply system.
Exam form	Written
Teaching/learning and examination requirements	Complete mastery of theoretical and methodological concepts and practical knowledge of the discipline, the ability to correctly reflect the results of analysis, independently reason about the processes being studied and carry out tasks in the current, intermediate forms of control and independent work, pass written work on the final control. When drawing up final exam questions, deviations from the content of the discipline program are not allowed. The bank of final exam questions for each discipline is discussed at the meeting and approved by the head of the department. No later than 1 week before the start of the final control, tickets signed by the head of the department, enclosed in an envelope, are sealed by the Dean's office and opened 5 minutes before the start of the exam in the presence of students. Final exam duration is 80 minutes. Answers to final exam questions are recorded in copybooks with the seal of the Dean's office. After completion of the final work, the work is immediately encrypted by a representative of the Dean's office, and the copybooks are handed over to the commission for verification. From the moment of completion of the final exam, a period of 72 hours is allotted for checking and posting the results on the electronic platform. The teacher who taught the students in this discipline is not involved

	in the process of conducting the exam and checking the students' answers. Student(s) who are dissatisfied with the final exam results may submit a written or oral appeal within 24 hours of the publication of the final exam results. Complaints submitted after 24 hours from the publication of the final exam results will not be accepted.
Scope of assessment criteria and procedure	CURRENT CONTROL Purpose: Determining and assessing the student's level of knowledge, practical skills, and competencies on course topics. Instructions: The student's activity in daily classes is assessed through the student's mastery of course topics, as well as constructively interpreting and analyzing the educational material, developing module-specific skills, acquiring practical skills (in terms of quality and the specified number) and competencies, solving problem situations aimed at applying professional practical skills, working in a team, preparing presentations, etc. Current control form: Activity in lessons Preparing educational materials Working with sources within the subject Using educational technologies Working in a team Preparing presentations Working with projects. MIDTERM CONTROL Purpose: Assessing the student's knowledge and practical skills and level of mastery of lecture material after completing the relevant section of the course. Form and procedure of intermediate control: Midterm examination is held during the semester during the training sessions after the completion of the relevant module of the curriculum of the subject. Midterm examination is held once in written form within the framework of this subject. Midterm examination questions cover all topics of the subject. INDEPENDENT LEARNING Purpose: Independent learning is aimed at fully covering the content of this course, expanding the theoretical knowledge acquired, and establishing independent learning activities for students. Form and procedure of independent education: independent work assignments are completed in the form of an educational project, presentation, case study, problem solving, information search, digest, colloquium, essay, article, abstract, etc. Completed assignments for independent study are placed in the electronic system and checked based on the anti-plagiarism program and evaluated by the subject teacher. In this case, the uniqueness of the completed assignment should not be less than 60%, otherwise the assignment will not be accepted for assessment. The number of independent work assignments, depending on the nature of the subject, should not be less than 3 for one subject (module). Independent work assignments account for 60% of the points allocated for current and intermediate control. FINAL CONTROL Purpose: The final examination is held at the end of the semester to determine the level of mastery of the student's theoretical knowledge and practical skills in the relevant subject. The final examination is held at a specified time according to the examination schedule created by the Registrar's Office on the electronic platform. Requirements: The student must have passed the current control, intermediate control and independent learning assignments by the deadline for the final control type in the relevant subject. A student who has not passed the current control, intermediate control and independent learning assignments, as well as who has received a score in the range of "0-29.9" for these assignments and control types, is not included in the final control type. Also, a student who has missed 25 percent or more of the classroom hours allocated to a subject without a reason is excluded

from this subject and is not included in the final control type and is considered not to have mastered the relevant credits in this subject. A student who has not passed or was not included in the final control type and has received a score in the range of "0-29.9" for this type of control is considered to be an academic debtor.

Final control form: The final examination in this subject will be conducted in written form. If the final examination is conducted in written form, the requirements for assessment must also be reflected.

Criteria for assessing student knowledge

5 grade	100 points		Assessment criteria
5	90-100	Excellent	When a student is considered to be able to make independent conclusions and decisions, think creatively, observe independently, apply the knowledge he has gained in practice, understand, know, express, and narrate the essence of the subject, and have an idea about the subject.
4	70-89,9	Good	When the student is considered to be able to observe independently, apply the knowledge he has gained in practice, understand, know, express, and narrate the essence of the subject, and has an idea about the subject.
3	60-69,9	Satisfactory	When the student is found to be able to apply the knowledge he has gained in practice, understands, knows, can express, and narrate the essence of the subject, and has an idea about the subject.
2	0-59,9	Unsatisfactory	When it is determined that the student has not mastered the science program, does not understand the essence of the subject, and does not have an idea about the science.

Course assessment criteria and procedure

Assessment type	Total points allocated	Control (task) form	Distribution of points	Qualifying score
Current assessment	30 points	System tasks	20 points (divided by the number of tasks)	18 points
		Student activity (in seminars, practical, laboratory classes)	10 points	
Midterm assessment	20 points	Supervision: Written work	10 points	12 points
		System tasks	10 points (divided by the number of tasks)	
Final assessment	50 points	Written assignment (5 questions)	50 points (10 points per question)	30 points

* Note: 60% of the points allocated for current and intermediate control are allocated to independent work assignments. Independent work assignments are evaluated as system assignments through the electronic platform.

Recommended Literature	**Main literature:** 1. Steven W.Blume. Electric Power System Basics. USA. Wiley – Intersciense A John Wiley&Sous, INC Publication, 2007, 260 p. 2. Saidkhodjayev A.G. Urban electricity supply. Textbook. – T.: Fan-tekhnologiya, 2015. 3. Козлов В.А. Электроснабжение городов.Учебник. -Л.: «Энергоатомиздат», 1988г. -263с. 4. Ополева Г.Н. Схемы и подстанции электроснабжения: Справочник: Учебное пособие. – М.: ФОРУМ: ИНФРА-М, 2006. – 480 с. 5. Тульчин И.К. Нудлер Г.И. «Электрические сети жилых и общественных заданий». – М.: Энергоатомиздат, 1999. **Additional literature:** 6. Mirziyoyev Sh.M. Development Strategy of New Uzbekistan. 2nd supplemented edition. – T.: Uzbekistan, 2022. – 44 p. 7. Соколова Е.М. Электрическое и электромеханическое оборудование: общепромышленные механизмы и бытовая техника, -М.: Изд «Мастерство» 2001. 8. Конюхова Е.А. Электроснабжение объектов: Учебное пособие. -М: Изд «Мастерство», 2001. **Internet resources:** 9. www.gov.uz – Government portal of the Republic of Uzbekistan. 10. www.catback.ru – International scientific articles and educational materials website. 11. www.google.ru – International educational materials search website. 12. www.ziyonet.uz – National educational materials search website. 13. www.lex.uz – National database of legislative documents UzRes.