Name of subject	**Energy audit of electrical systems (ECTS 8)**
Subject/module code	ETEA26708
Science taught semester (s).	6th and 7th semesters
Responsible teacher	Nazarov Furkat Daminovich, senior teacher.
Education language	Uzbek
Connection to the curriculum	Elective
Training hours (this including independent education)	**Total hours-240.** **Audience Training hours – 96** 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 goal of teaching the subject is to teach students the fundamentals of rational use of energy, standardization of consumption by energy form, energy conservation management, use of secondary energy resources, and the implementation of energy conservation policies in practice. The task of the discipline is to evaluate methods for controlling current energy consumption at a facility, study energy management processes and practices, energy management information systems, energy audit methods, develop measures to increase energy efficiency, and study their feasibility. **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. To have an idea of systematic analysis in solving organizational and technical issues in managing the energy sector of industrial enterprises. 5. Study of key performance indicators for various types of energy devices and opportunities for their improvement. 6. Economic assessment of service quality and its competitiveness by type of energy devices. 7. Knowledge of and ability to use the main legal and regulatory documents available in the field.
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions)** **Topic 1:** Goals and objectives of instrumental energy audit at industrial enterprises **Topic 2:** Types and methods of measurements in instrumental energy audit **Topic 3:** Insulators and line fittings. Cable structure and cable lines. **Topic 4:** Standardization of electrical energy consumption at industrial enterprises **Topic 5:** Current state of energy consumption. Statistical reports. **Topic 6:** Direct measurement of energy and energy carrier consumption **Topic 7:** Partial and indirect measurement of energy and energy carrier consumption parameters **Topic 8:** World experience in the application of new energy-saving technologies in industry **Topic 9:** Assessment of electricity consumption by lighting systems

	and electrical appliances **Topic 10:** Assessment of electricity consumption by air conditioners and office equipment **Topic 11:** Calculation of heat energy consumption by consumers **Topic 12:** Energy balance and its types **Topic 13:** Methods and equipment for conducting energy audits **Topic 14:** Definitions for heat and electricity **Topic 15:** Calculation of electricity consumption by consumers **Topic 16:** Accounting for natural gas by consumers **Topic 17:** Heat and gas supply systems of industrial enterprises **Topic 18:** Energy saving due to reactive power compensation **Topic 19:** Cross-sectional audit of energy consumption **Topic 20:** Analysis of the efficiency of energy consumption at the facility **Topic 21:** Definition of enterprises and buildings **Topic 22:** Feasibility study of energy-saving measures **Topic 23:** Development of energy-saving recommendations **Topic 24:** Analysis of energy use by the end consumer. **II. Instructions and recommendations for organizing laboratory exercises.** In laboratory exercises, students develop practical skills and competencies in various indicators of processes in Energy audit of electrical 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. Energy saving reserves and energy saving measures in various sectors of industry 2. World experience in the application of new energy-saving technologies in industry 3. Power supply system of industrial enterprises 4. Determination and adjustment of the efficiency of heat exchange devices used in industry 5. Heat and gas supply systems of industrial enterprises 6. Compilation of exergy balances of heat-consuming devices 7. Thermal schemes and efficiency of modern steam and gas plants. 8. Settlement with consumers for electricity at a flat rate 9. Correct selection of electric motors by power 10. Saving electricity using reactive power compensation 11. Examples of compiling an energy audit report 12. Calculation of the technical and economic efficiency of energy-saving measures. **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. Application of new energy-saving technologies in industrial heat supply systems 2. Assessment of energy consumption by electric heating and cooling

	devices 3. Assessment of energy consumption by steam heating devices 4. Steam-gas device with steam spraying 5. Energy efficiency in industry 6. Heat supply in compressor equipment utilization devices 7. Energy saving in the gas industry 8. Energy saving in boiler houses 9. Operating modes of boiler plants 10. Energy saving in heat supply systems 11. Reducing heat loss through the use of double-chamber windows 12. Infrared heating system for industrial facilities. **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. Comparison of energy consumption data 2. Cross-sectional energy consumption audit 3. Analysis of energy consumption efficiency at the facility 4. Description of the enterprise and buildings 5. Feasibility study of energy saving measures 6. Development of energy saving recommendations 7. Analysis of energy use by the end consumer 8. Energy distribution and energy conversion 9. Development and evaluation of energy consumption improvement projects 10. Energy saving in heat supply systems 11. Saving electricity using reactive power compensation 12. Feasibility study of energy saving measures 13. Development of energy saving recommendations 14. Analysis of energy use by the end consumer 15. Energy distribution and energy conversion 16. Development and evaluation of energy consumption improvement projects 17. Energy saving in heat supply systems 18. Reducing heat loss through the use of double-chamber windows 19. Energy saving in electrical networks.
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. Липкин Б.Ю., "Электроснабжение промышленных предприятий и установок", Учебник. -М.: "Высшая школа", 1980. 3. Кудрин Б.И., Электроснабжения промышленных предприятий. Учебник. -М.: Интермет Инжиниринг, 2005. 4. Qodirov T.M., Alimov H.A., «Sanoat korxonalari elektr ta'minoti», O'quv qo'llanma, ToshDTU. -T.: 2006. 5. Qodirov T.M., Alimov H.A., «Sanoat korxonalari va fuqoro binolarining elektr ta'minoti», O'quv qo'llanma, ToshDTU. -T.: 2007. 6. Taslimov A.D., Rasulov A.N., Usmonov E.G., elektr ta'minoti», O'quv qo'llanma Электр таъминоти. Ilm-ziyo. -T.: 2012. **Additional literature:** 7. O'zbekiston Respublikasini yanada rivojlantirish bo'yicha Harakatlar strategiyasi to'grisida-T.2017yil 7 fevral,PF-4947-sonli Farmoni. 8. Uzbekistan Respublikasi «Energiyadan oqilona foydalanish togrisida» qonuni. 2019 y. 9. Конюхова Е.А., Электроснабжение объектов: Учебное пособие. -М.: Издательство «Мастерство»; Высшая школа, 2001. 10. Ополева Г.Н., Схемы и подстанции электроснабжения: Справочник: Учебное пособие. - М.: ФОРУМ: ИНФРА-М, 2006. 11. Гулямов Б.Х., Салиев А.Г., Ташпулатов Б.Т., Тешабаев Б.М., Правила устройства электроустановок. Узгосэнергонадзор. -Т.: 2007. 12. Аллаев К.Р., Энергетика мира и Узбекистана. Аналитический обзор. -Т.: Издательство «Молия», 2007. 13. Аллаев К.Р., Электроэнергетика Узбекистана и мира. -Т.: «Фан ва технология», 2009. **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.