Name of subject	**Energy audit equipment and measurement methods (ECTS 10)**
Subject/module code	EAJO‘U21210
Science taught semester (s).	1st and 2nd semesters
Responsible teacher	Nazarov Furkat Daminovich (PhD), senior teacher.
Education language	Uzbek
Connection to the curriculum	Elective
Training hours (this including independent education)	**Total hours-300** **Audience Training hours – 90** Lecture training hour – 46 Practical training hour – 44 **Independent education -210 hours**
ECTS	10
The purpose and tasks of subject / learning outcomes	**The purpose of teaching the subject** is to the main goal of “Energy audit equipment and measurement methods” is to teach students the basic essence of energy conservation policy, to use energy wisely, to normalize consumption in energy forms, to manage energy savings, to use secondary energy resources, to implement energy saving measures in practice and to generate the skill of using energy. **The task of the subject** is to are the types and reserves of secondary energy sources generated in energy, energy-technological devices and technologies in industrial enterprises, analysis of the characteristics and potentials of the exit gases of heat technology devices, drawing up the energy and exergy balance of heat technology devices, methods of calculating efficiency, waste consists in mastering the principles of heat utilization. **Learning outcomes:** 1. The ability of enterprises to get an idea in a systematic taxable framework in solving organizational and technical issues in the management of the enrtgetic economy. 2. The importance of how to form an energy passport of enterprises. 3. Development of energy efficient slurry proposals that meet energy efficiency requirements. 4. To know and be able to use the technical parameters of Energoaudit measuring instruments. 5. The main performance indicators and options for their improvement in different types of energy devices. 6. Eneregetic equipment improve work productivity. 7. Study of Energoaudit measuring instruments. 8. Be able to know and use the existing basic legal and regulatory documents in the field
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions)** **Topic 1:** Goals and objectives of instrumental energy audit in enterprises. **Topic 2:** Methodology and basic principles of energy audit. **Topic 3:** Types and methods of measurements in instrumental energy audit. **Topic 4:** Normalizing electricity consumption in enterprises. **Topic 5:** Current energy consumption status.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**. Energetik balans va uning turlari. **Topic 9:** Methods and equipment for conducting energy audits. **Topic 10:** Boiler-utilizers of steel melting and rolling production. **Topic 11:** Calculation of heat energy consumption by consumers.

	Topic 12: General terms of modern measuring instruments necessary for conducting energy research and energy auditing. **Topic 13:** Modern measuring instruments for determining power, electricity, quality and phase difference. **Topic 14:** Modern measuring instruments for energy audits in heating systems. **Topic 15:** Modern measuring instruments for energy audits of pumping units **Topic 16:** Modern measuring instruments for energy tracking in lighting devices**.** **Topic 17:** Modern measurement instruments for energy audits in compressed air systems. **Topic 18:** Modern measuring instruments for energy audits of air exchange (ventilation) systems of enterprises and organizations. **II. 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. Types and procedure of energy research 2. Energy audit of technical systems of enterprises 3. Calculation of the total heat content of waste gases. 4. Determination of fuel savings when using waste gas heat. 5. Calculation of the combustion process in use of exhaust gases containing combustible gases 6. Energy saving when low-temperature heat carrier is disposed. 7. Energy saving in the use of a steam-gas device. 8. Calculation of energy saving potentials in hot water, steam production and distribution systems. 9. Assessment of energy consumption by gas heating devices. 10. Energy saving in the use of heat pumps. 11. Calculation of technical and economic efficiency of energy-saving measures. 12. Power quantity and quality analyzer device 13. Parameters of the device temperature measurement equipment **III. 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.General rules and legal framework 2.Energy audits and organization of energy audit 3.Rights and responsibility during energy audit 4.Requirements of consumers of fuel and energy resources 5.General concepts of the necessary modern measuring instruments for energy inspection and energy audit 6.Modern measuring devices for determining power, electricity, quality and phase voltage difference.

	7.Modern measuring devices for energy audits in heat supply systems. 8.Modern measuring instruments for energy audits in pumping units 9.Modern measuring instruments for energy audits in lighting devices 10.Modern measuring instruments for energy audits in compressed air systems 11.Modern measuring instruments for energy audit in air exchange (ventilation) systems of enterprises and organizations 12.First level energy survey 13.Energy survey of the second level (in-depth energy survey) 14.Types and order of energy surveys 15.Development of a program for energy audits and energy audits and the procedure for registration. 16.Energy audit of power supply systems: energy losses in power grids; energy losses in transformers; energy losses in electric motors 17.Energy audit in pumping unit systems 18.Energy audit in heat supply systems 19.Energy audit in lighting systems 20.Energy audit in air exchange (ventilation) systems of enterprises 21.Energy audit in compressed air systems of enterprises and organizations 22.Electricity balance 23.Methods of economic valuation in water consumption systems 24.The procedure for the development and economic assessment of energy saving 25.The procedure for preparing the final energy audit report
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. Energiya nazorati va yoqilg'i-energetika resurslari iste'molchilarining ekspertizalarini o'tkazish qoidalari. O'zbekiston Respublikasi Vazirlar Mahkamasining 2006 yil 7 avgustdagi 164-sonli qarori.
2. Allaev K.R., Xoshimov F.A.. Знергосбережения на промыщленных предприятиях. Tashkent: Izd-vo «Fan» AN RUz, 2011. - 208s.
3. Безлепкин В.П. Парогазове и паротурбинне установки електростансий. СПб.: Изд-во СПбГТУ, 1997. 295 с.
4. Цанеев С.В. Газотурбинне и парогазове установки тепловх електростансий: учебное пособие для вузов/
5. С.В. Санеев, В.Д. Буров, А.Н. Ремезов; под ред. С.И. Цанаева.

М.: Изд-во МЕИ, 2002. 584 с.
6. Фаворский О.Н. Технологические схем и показатели экономичности ПГУ с впрском пара в газовй тракт/О.Н. Фаворский, С.В. Санеев, В.Д. Буров, Д.В. Карташов// Теплоенергетика. 2005. №4. С. 28 - 34.
7. Wайне с. Турнер, Стеве Дотй. Энергй манагемент Ҳандбоок. ИСБН: 0-88173-542-6 (принт) -0-88173-543-4 (элестронис).2006. 909
8. А.П. Воинов, Л.И. Купермен, С.П. Сушон. “Паровие котли на отходяших газах, Киев 1983.
18. Журнал «Проблемы энерго- и ресурсосбережения». - Ташкент: Издателство ТашГТУ. №№ И -4, 2003 г. и последующие впуски.
9. Правила ползования тепловой энергией. Ташкент: Узгосэнергонадзор, 2005.
10. Shaislamov A.SH., Matchanov E.K., Energetika va texnologiyalarda issiqlikdan foydalanish., Ma’ruza matnlari., 2000.

Additional literature:

1. Allaev K.R., Xoshimov F.A.. Знергосбережения на промыщленных предприятиях. Tashkent: Izd-vo «Fan» AN RUz, 2011. - 208s.
2. Безлепкин В.П. Парогазове и паротурбинне установки електростансий. СПб.: Изд-во СПбГТУ, 1997. 295 с.
3. Цанеев С.В. Газотурбинне и парогазове установки тепловх електростансий: учебное пособие для вузов/
4. С.В. Санеев, В.Д. Буров, А.Н. Ремезов; под ред. С.И. Цанаева. М.: Изд-во МЕИ, 2002. 584 с.
5. Фаворский О.Н. Технологические схем и показатели экономичности ПГУ с впрском пара в газовй тракт/О.Н. Фаворский, С.В. Санеев, В.Д. Буров, Д.В. Карташов// Теплоенергетика. 2005. №4. С. 28 - 34.
6. Рационалное исползование газа в енергетических установках : справочное руководство/ Р.Б. Ахмедов [и др.]. ЖЛ: Недра, 1990. 423 с.
7. А.П. Воинов. Л.И. Купермен, С.П. Сушон. Парове котл на отходящих газах. Киев. Всшая школа. 1983.

Internet resources:

33. www.lex.uz – National database of information on legal documents of the Republic of Uzbekistan.
34. www.ziyonet.uz – national educational materials search site.
35. www.gov.uz – Government portal of the Republic of Uzbekistan.
36. www.google.com – international educational materials search site.
37. www.energystrategy.ru – “Energy Policy and Strategy” information portal
38. www.twirpx.com – international educational materials search site.