Name of subject	Energy audit of buildings and communal facilities (ECTS 4)
Subject/module code	BKXEA2204
Science taught semester (s).	2nd semester
Responsible teacher	Anarboev Mukhiddin Almanovich, PhD., associate professor.
Education language	Uzbek
Connection to the curriculum	Elective
Training hours (this including independent education)	**Total hours-120** **Audience Training hours - 36.** Lecture training hour – 18 Practical training hour – 18 **Independent education -84 hours**
ECTS	4
The purpose and tasks of subject / learning outcomes	**The purpose of this course** The role of the electric power industry in the rapid development of the economy is incomparable. Due to the stable operation of the energy system of Uzbekistan, the national economy is provided with uninterrupted and high-quality electric energy. This process, in turn, increases the demand for the training of highly qualified personnel. This program reflects the goals, objectives, and content of the subject "Energy Audit of Buildings and Utilities". In-depth study of the subject of the introduction to the direction plays an important role in solving the problems of the harmful effects of energy on the environment. Students will study the structure and operating principles of devices powered by alternative sources, such as solar energy systems, heat pumps, low-potential energy sources, wind turbines, biogas plants, and geothermal units. The course emphasizes the practical applications of renewable energy systems, focusing on system design, energy accumulation and storage, hybrid operation of conventional and non-conventional sources, and the future prospects of the renewable energy sector. By completing this course, students will be able to develop and evaluate engineering solutions for the integration of renewable energy systems, optimize their performance, and assess their technical and economic viability for use in Uzbekistan's energy infrastructure. They will also gain awareness of ecological implications and the global shift toward sustainable energy development. **The objective of the course** *"Energy audit of buildings and communal facilities"* The goal of studying the subject is to develop skills and competencies in students in the classification and structural structure of the energy sector, the processes of generating electricity, and the effective operation of electrical devices under specific operating conditions. Learning Outcomes: 1. To acquire knowledge about the planning, installation, and commissioning of energy devices based on alternative energy sources. 2. To study the structure, operating principles, and fundamental concepts of utilizing adapted energy systems. 3. To explore the global development and implementation processes of unconventional and renewable energy technologies (URETs). 4. To understand the methods of converting natural and secondary energy sources into thermal and electrical energy. 5. To develop skills in calculating according to assessment

	parameters of unconventional and renewable energy sources. 6. To build competence in drawing principle circuit diagrams of renewable energy system devices. 7. To develop the ability to determine the extractable power of devices based on renewable energy technologies through calculations and to operate such systems effectively. 8. To assess the feasibility of using renewable energy technologies in the natural conditions of the Republic of Uzbekistan
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions)** Topics: 1.Introduction. Basic principles of energy audit. 2.General methodology of energy audit in residential and household buildings. 3. Legal and regulatory framework of energy audit. 4. Rules for conducting energy audit 5. Types and tasks of energy audit in residential and household buildings. Main stages of energy audit and their composition. 6. Methodology of energy audit of residential and household buildings. 7. Fundamentals of energy audit of heat consumption in residential and household buildings. 8. Typical algorithm of energy audit in a heating boiler room. 9. Analysis of operating modes of the heating system. 10. Energy audit of heat supply systems. 11. Calculation of the resistance of building structures to thermal conductivity. 12. Requirements for thermal conductivity resistance depending on the types of buildings in the KMC 13. Thermal insulation and densification of building structures with thermal insulation. 14. Analysis of the operating modes of boiler plants. 15. Analysis of the completeness of the combustion process in boiler plants. 16. Cleaning and prevention of contamination in heat exchange devices and pipes. 17. Energy passport of the building and its purpose. Fundamentals and tasks of energy monitoring **II. Instructions and recommendations for organizing laboratory exercises.** Laboratory work is not included in the curriculum **III. Practical training instructions and recommendations** The instructor's preparation for a practical session begins with the study of initial documents (such as the curriculum, topic schedule, etc.) and concludes with the development of a detailed lesson plan. The instructor must have a clear understanding of the objectives and tasks of the practical session, as well as the amount of work each student is expected to perform. Recommended Practical Topics: 1. Calculation of the maximum hourly heating load 2. Calculation of the maximum hourly ventilation load 3. Calculation of the maximum hourly hot water supply load 4. Energy fuel 5. Combustion of products in the boiler room 6. Calculation of the volume of combustion products in the boiler room 7. Calculation of convective surfaces of the boiler

	8. Calculation of heat transfer of heating devices 9. Calculation of air exchange in the building 10. Calculation of air exchange in residential and household buildings 11. Calculation of heat losses in hot water and heating systems 12. Calculation of heat losses in centralized heating points 13. Calculation of losses in power supply systems 14. Calculation of main losses of buildings 15. Drawing up an energy passport of the building. **IV. Independent learning and practical exercises** The purpose of independent work is to consolidate and deepen theoretical and practical knowledge obtained in lectures, experiments and practical exercises in the subject, taking into account scientific and technical innovations. Independent work is formalized in written form (stand, software, demonstration device, abstract, graphical calculation work, etc.), taking into account the requirements of relevant regulatory documents. Independent work provides for the acquisition of more in-depth knowledge of the subject under study, using various information sources, including literature, journal articles, computer resources (Internet), etc. Recommended topics for practical exercises: 1. Extensive study of legal and regulatory documents related to energy audits of households and buildings 2. Comprehensive study of the rules for conducting energy audits and energy expertise 3. Energy saving potential and energy saving measures in household buildings. 4. Method of conducting a boiler regime (compilation of a regime card) 5. Application of new energy-saving technologies in household buildings (Heat pumps, "Fisonic" technology, use of new heat exchangers, etc.) 7. Energy saving potential and energy saving measures in household buildings. 2nd semester 8. Modern automated heat points 9. Modern lighting equipment and reactive power compensators 10. Energy management systems and main stages of buildings. 11. Methods of statistical processing of databases 12. Energy management systems for buildings and their main stages. 13. Standards for certification of building energy efficiency. 14. Monitoring of building energy consumption.
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.					

Recommendation done literature

Main literature:

1. Закон Республики Узбекистан «О рациональном использовании энергии» 1997 г.
2. Материалы широкомастабного совместного проекта ПРООН/ГЭФ и Правительства Узбекистана «Повышение эффективности зданий социального назначения в Узбекистане» 2011 г.
3. Постановление Кабинета Министров РУз №164 «Правила проведения энергетичемского аудита и энергетических экспертиз потребителей ТЭР». 07.08.2006 г.
4. Постановление Кабинета Министров Республики Узбекистан № 13 «О мерах по разработке концепции реформирования системы теплоснабжения и программы модернизации и развития системы теплоснабжения в республике на период 2009-2015 годы» 2009 г.
5. КМК 2.01.04-97 Строительная теплотехника. Госкомархитектстрой РУз- Ташкент:1997.
6. КМК 2.04.05-97 Отопление, вентиляция и кондиционирование. Госкомархитектстрой РУз-Ташкент: 1997.
7. КМК 2.08.04-04 Нормативы расхода энергии на отопление, вентиляцию и кондиционирование зданий и сооружений. Госкомархитектстрой РУз- Ташкент:2004.
8. КМК 2.01.18-00 Административные здания Госкомархитектстрой РУз- Ташкент:2000.

Additional literature:

9. КМК 2.03.10-95 Крыши и кровли. Госкомархитектстрой РУз-Ташкент: 1995
10. ШНК 2.08.02-09 Общественные здания и сооружения. Госкомархитектстрой РУз-Ташкент:2009.
11. Здания и сооружения, приспосабливаемые под лечебные учреждения. Госкомархитектстрой РУз-Ташкент: 1997.
12. Богословский В.Н., Поз М.Я.. Теплофизика аппаратов утилизации тепла систем отопления, вентиляции и кондиционирования воздуха. М., Стройиздат, 1983.
13. Энергосбережение в системах теплоснабжения, вентиляции и кондиционирования воздуха. (Справочное пособие), под ред. Богуславского Л.Д., М., Стройиздат, 1990.
14. Mirziyoyev SH.M. Tankidiy taxlil, kat’iy tartib-intizom va shaxsiy javobgarlik - xar bir raxbar faoliyatining kundalik koidasi bulishi kerak. Uzbekiston Respublikasi Vazirlar Maxkamasining 2016 yil yakunlari va 2017 yil istikbollariga bagishlangan majpisidagi Uzbekiston Respublikasi Prezidentining nutqi. // “Xalq so’zi” gazetasi.
15. 2017 y.. 16 yanvar, №11.
16. O’zbekiston Respublikasi Konstitutsiyasi. - T.: Uzbekiston, 2017. - 46 b.
17. Mirziyoyev SH.M. Buyuk kelajagimizni mard va olijanob xalkimiz bilan birga kuramiz. - T.: “Uzbekiston” NMIU, 2017. - 488 b.
18. O’zbekiston Respublkasini yanada rivojlantirish buyicha Harakatlar strategiyasi tugrisida. - T.:2017 yil 7 fevral, PF-4947-sonli Farmoni.
19. «Правила проведения энергетичемского аудита и энергетических экспертиз потребителей ТЭР». Постановление

	Кабинета Министров РУз №1640708.2006 г. 20. Правила пользования тепловой энергией. Ташкент: Узгосэнергонадзор, 2005. 21. Правила пользования электрической энергией. Ташкент: Узгосэнергонадзор, 2005. 22. Методические указания по определению расходов топлива, электроэнергии и воды на выработку тепла отопительными котельными коммунальных теплоэнергетических предприятий. Москва, Академия коммунального хозяйства им. Памфилова, 1994 г. 23. Энергоаудит промышленных и коммунальных предприятий. Учебное пособие. Б.П.Варнавский, А.И.Колесников, М.Н.Федоров. Издательство АСЭМ, М., 1999 **Internet sites:** 1. www.gov.uz –Government portal of the Republic of Uzbekistan. 2. www.catback.ru – international scientific articles and educational materials website. 3. www.google.ru – international educational materials search website. 4. www.ziyonet.uz – national educational materials search website. 5. www.lex.uz – national database of legal documents and information. 6. www.catback.ru – scientific articles and educational materials.