Subject name	Digital Energy (ECTS 4)
Topic/module code	RENER2304
Semesters in which the subject is taught	3rd semester
Adjunct teacher	Baratov Laziz son of Suyun
Language of instruction	Uzbek
Science type	Selection
Study hours (including independent study)	**Total hours - 120 .** **Classroom hours - 48.** Lecture hours - 24 Laboratory hours - 12 Practical hours - 12 Independent learning - 72 hours
ECTS	4
The purpose and objectives of science / learning outcomes	**The aim of teaching the subject** is to develop students' skills in the concept of digital energy and the implementation of digital energy technologies in the power supply system. At the same time, it is to comprehensively study smart grids and digital substations in the power system. **The task of the subject** is to comprehensively teach students about digital energy and its application in the power supply system, to develop skills in using digital devices in the process of automatic control and accounting of energy consumption in the power supply system, and to comprehensively teach all issues related to the basic concepts, economic and technical calculations of digital energy**.** **Learning outcomes:** 1. To study the prospects for the introduction of digital energy technologies in the power supply system. 2. To study in detail smart grids and digital substations in the power system 3. To study the state policy in the energy sector and its development trends and prospects in the country and the world. 4. To economically assess the competitiveness of traditional and unconventional methods of electricity generation. 5. To have a complete picture of the equipment and devices of power grids and systems.
Course content (topics)	**I. Main theoretical part (Lecture)** **Topic 1:** History and classification of digital energy development. Concept and types of digital energy. History of digital energy development. Current status of application of digital technologies in the power supply system. Digital technologies in the power supply system. **Topic 2:** Digital regulation and standardization of electric energy**.** **Topic 3:** Principles of creation and construction of automatic control systems in the power system**.** **Topic 4:** Introduction of SCADA systems in the power system **Topic 5:** Organization of a data processing system in the power system. **Topic 6:** Development of the principles of Smart-grid, micro-grid in electric energy. **Topic 7:** Digitalization of the fuel and energy complex. Digital oil and gas industry. Digital energy industry. **Topic 8:** Energy accounting - the role of a green economy in energy saving. **Topic 9:** Technical and software tools of an automated system **Topic 10:** Control of the quality of electric energy using an automated system. Main quantities characterizing the quality of electricity **Topic 11:** Digital technologies in energy. Digital services.

	Application of analytical services. **Topic 12:** Digital transformation in energy. The concept of digital transformation in energy. Intelligent systems and their structural structure. **II. Instructions and recommendations for organizing laboratory exercises.** In laboratory exercises, students develop practical skills and competencies in calculating and drawing tables and graphs, conducting experiments, and analyzing various indicators of processes in electrical networks and systems. The proposed topics are selected based on opportunities and conditions. **Recommended topics for laboratory work:** 1. Familiarization with the automated system of control and accounting of electricity. 2. Study of Automated system for monitoring and accounting of electrical energy in the energy system of Uzbekistan. 3. Study of modern electricity meters. 4. Study of data collection and processing in Automated system for monitoring and accounting of electrical energy software. 5. Study of technical means of Automated system for monitoring and accounting of electrical energy. 6. Study and analysis of Automated system for monitoring and accounting of electrical energy at the level of power plants. **III. Instructions and recommendations for practical training** The teacher's preparation for a practical training begins with the study of the initial 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, the amount of work that each student must perform. Methodological instructions are the main methodological document of the teacher in preparing and conducting practical training. The purpose of a practical training is to understand the theory, acquire skills. It is to develop the ability to consciously apply it in educational and professional activities, to confidently form one's own point of view. **Recommended practical topics:** 1. Energy based on non-traditional renewable energy sources. 2. Smart grids. 3. Dispatching engineering systems of the electric power industry. SCADA. 4. Automated systems of electric power. 5. Automated lighting control 6. Transition to a digital substation. Communication protocols in the electric power industry**.** **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. **Independent study for the recommended topics:** 1. Electrical efficiency calculation programs 2. Energy based on non-traditional renewable energy sources. 3. Description of the systematic scheme of the process from energy production to its consumption 4. Transition to a digital substation. Communication protocols in the electric power industry 5. Use of digital technology structures in industrial enterprises

	6. Digital transformation in energy 7. Digital regulation and standardization of electric power 8. Study of modern electricity meters. 9. Study and analysis of EENHAT at the level of power plants. 10. Systems ensuring the cyber security of the substation in the formation of a digital structure. 11. Energy accounting is a means of energy saving. 12. Control of the quality of electricity using an automated system.
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 Digital Energy course, students are evaluated on a 100-point system. Of these, 50 points are allocated to the current and intermediate results (60% of the 50 points are current control, independent learning and 40% are intermediate control), and 50 points are allocated to the final control result. 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. Steven W.Blume. Electric Power System Basics. USA.: Wiley – InterscienseA John Wiley&Sous, INC Publication, 2007, 260 p 2. Saidxodjaev A.G. Shahar elektr ta'minoti. Darslik. – T.: Fan-texnologiya, 2015. 3. Козлов В.А. Электроснабжение городов. Учебник. -Л.: «Энергоатомиздат», 1988г. -263ст. 4. Ополева Г.Н. Схемы и подстанции электроснабжения: Справочник: Учебное пособие. – М.: ФОРУМ: ИНФРА-М, 2006. – 480 ст. 5. Холянов В.С., Холянова О.М. «Электроснабжение непромышленных объектов». Учебное пособие – М.: Владивосток, 2007. 6. Qodirov T.M., Alimov X.A., Rafikova G.R. Sanoat korxonalari va fuqaro binolarining elektr ta'minoti. O'quv qo'llanma. –Toshkent: 2007. -190 bet. 7. Qodirov T.M. Alimov X.A. «Sanoat korxonalarining elektrta'minoti» O'quv qo'llanma, ToshDTU. -T.: 2006. -210 bet. 8. TaslimovA.D., Meliqo'ziyevM.V. "Shahar elektr ta'minoti", O'quv qo'llanma, ToshDTU. -T.: 2022. -200 bet.

	Additional literature: 9. O'zbekiston Respublkasini yanada rivojlantirish bo'yicha Harakatlar strategiyasi to'g'risida. - T.:2017 yil 7 fevral, PF-4947-sonli Farmoni. 10. Конюхова Е.А. Электроснабжение объектов: Учебное пособие. -М: Изд «Мастерство», 2001. 11. Козлов В.А. и др.- Электроснабжение городов. Справочник. - Л.: «Энергатимиздат».1999. 12. ЕршовА.М. Системы электроснабжения, часть 5. Курс лекций -М.: Челябинск 2017, 190 ст. 13. Сазыкин В.Г. Проектирование систем электроснабжения. / Учебное пособие. –Краснодар, -М.: 2019,120ст. **Internet resources:** 16. www.ziyonet.uz – milliy o'quv materiallarini qidiruv sayti. 17. www.gov.uz – O'zbekiston Respublikasining hukumat portali. 17. www.google.com – xalqaro o'quv materiallarini qidiruv sayti. 19. www.energystrategy.ru – "Energetika siyosati va strategiyasi" axborot portali 20. www.twirpx.com – xalqaro o'quv materiallarini qidiruv sayti.