Subject name	Digital Energy (ECTS 4)
Topic/module code	RENER2304
Semesters in which the subject is taught	3rd semester
Adjunct teacher	Baratov Laziz Suyun ugli, assistant.
Language of instruction	Uzbek
Connection to the curriculum	Elective
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.
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 – 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.