

Name of subject	Measurements of production technological processes (ECTS 9)
Subject/module code	SPEQ23409
Science taught semester (s).	3 <sup>rd</sup> and 4 <sup>th</sup> semesters
Responsible teacher	Anarboyev Muhiddin Almanovich, PhD., associate professor
Education language	Uzbek
Connection to the curriculum	Elective
Training hours (this including independent education)	<b>Total hours-270.</b> <b>Audience Training hours - 108.</b> Lecture training hour – 60 Laboratory training hour – 24 Practical training hour – 24 <b>Independent education -162 hours</b>
ECTS	9
The purpose and tasks of subject / learning outcomes	<p><b>The purpose of teaching the subject</b> is to develop skills and competencies in students in the classification and structural structure of the energy sector, processes of electricity generation, and the effective operation of electrical devices under specific operating conditions..</p> <p><b>The task of the subject</b> is to 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 training highly qualified personnel.</p> <p>This program reflects the goals, objectives, and content of the subject “Electrical part of the station and substation”.</p> <p>In-depth study of the subject of the electrical part of the station and substation plays an important role in solving the problems of the harmful effects of energy on the environment.</p> <p><b>Learning outcomes:</b></p> <ol style="list-style-type: none"> <li>1. The course on the electrical part of the station and substation studies the equipment of the electrical part of the station and substation in the electric power system.</li> <li>2. High-voltage devices used in the electrical part of the station and substation.</li> <li>3. Devices with voltages below 1000 V used in the electrical part of the station and substation.</li> <li>4. Basic concepts in the field of electric power.</li> <li>5. Basic performance indicators for various types of equipment and opportunities for their improvement.</li> <li>6. Increasing the efficiency of electricity generation equipment.</li> <li>7. Economic assessment of the competitiveness of traditional and unconventional methods of electricity generation.</li> </ol>
Course content (topics)	<p><b>I. Main Theoretical Part (Lecture Sessions)</b></p> <p><b>Topic 1:</b> Introduction. Goals and objectives of the discipline “Electrical part of the station and substation”. History of the development of electric power in Uzbekistan. Nominal voltage of the elements of the electrical system and operating modes of neutrals.</p> <p><b>Topic 2:</b> Synchronous generators. Nominal parameters of generators. Structure of turbogenerators and hydrogenerators. Cooling system of generators. Air cooling systems. Hydrogen and water cooling systems of generators.</p> <p><b>Topic 3:</b> Excitation systems of synchronous generators. Self-excitation and independent excitation systems of generators.</p> <p><b>Topic 4:</b> Automatic adjustment of generator excitation. Field</p>

quenching of synchronous generators. Synchronous compensators

**Topic 5:** Types of power transformers and their parameters.

Cooling systems of power transformers. Natural cooling with air and oil

**Topic 6:** Integration of power plants consisting of renewable energy sources into power networks.

**Topic 7:** Structure and operating modes of autotransformers. Voltage adjustment of transformers. transformer voltage adjustment under load. Voltage adjustment in autotransformers.

**Topic 8:** Low-voltage devices, switchgear and reclosers.

**Topic 9:** Distribution systems at power plants and substations.

**Topic 10:** High-voltage circuit breakers. Low-oil circuit breakers. Air circuit breakers. Electromagnetic, vacuum circuit breakers. Gas-insulated and synchronous circuit breakers.

**Topic 11:** Network problems, electrical systems and their design, load stabilization.

**Topic 12:** Voltage transformers.

**Topic 13:** Selection of basic electrical equipment and current-carrying parts. Switchgear, automatic machine, contactor, fuse. Selection of current transformers and voltage transformers.

**Topic 14:** Selection of current transformers and voltage transformers.

**Topic 15:** Electrical connection diagram of stations and substations. Basic requirements for the main diagrams of electrical installations.

## **II. Instructions and recommendations for organizing laboratory exercises.**

In laboratory exercises, students develop practical skills and competencies in various indicators of processes in Measurements of production technological processes, conducting experiments, calculating and drawing tables and graphs. The recommended topics are selected based on opportunities and conditions.

### **Recommended topics for laboratory work:**

1. Connecting synchronous generators to the power system.
2. Studying the operating modes of generators.
3. Studying the connection groups, schemes and main parameters of transformer windings.
4. Parallel operation of transformers
5. Studying the load capacity of transformers
6. Checking the insulation control scheme in an alternating current network
7. Checking current transformers.
8. Checking voltage transformers.
9. Checking the oil-immersed switch and its drive mechanisms.
10. Remote control of switches
11. Studying fuse-links
12. Determining the mutual electrodynamic voltages of the buses..

### **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.

	<p><b>The following topics are recommended for practical training:</b></p> <ol style="list-style-type: none"> <li>1. Selection of conductors for continuous current.</li> <li>2. General information about digital substations</li> <li>3. Single and double-strip tires.</li> <li>4. Selection of low-voltage electrical equipment.</li> <li>5. Selection of base insulators.</li> <li>6. Selection of the number and power of insulators in the substation.</li> <li>7. Selection of high-voltage electrical equipment. Selection of circuit breakers.</li> <li>8. Selection of disconnectors.</li> <li>9. Selection of short-circuit and dividers.</li> <li>10. Selection of current transformers.</li> <li>11. Selection of voltage transformers.</li> <li>12. System diagrams of power plants and substations. Single-system busbar scheme.</li> <li>13. Electric arc and methods of extinguishing it. Two-system busbar scheme. Single-circuit busbar and single-system busbar scheme.</li> <li>14. Study of closed distribution devices and open distribution devices. The working bus system is a scheme of two working and circulating busbars, non-sectionalized and sectionalized.</li> <li>15. Own demand systems of stations and substations</li> </ol> <p><b>IV. Independent learning and independent work.</b></p> <p>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.</p> <p><b>Recommended topics for independent study:</b></p> <ol style="list-style-type: none"> <li>1. Operating modes of neutrals of electrical devices;</li> <li>2. Electrical load graphs;</li> <li>3. Automatic extinguishing of the generator field;</li> <li>4. Neutral operating modes of power transformers in the power system and insulation testing;</li> <li>5. Methods for calculating short circuits in power systems;</li> <li>6. Thermal and dynamic effects of short circuit currents;</li> <li>7. Electric arc and methods for extinguishing it;</li> <li>8. Grounding devices;</li> <li>9. Electrical connection schemes of stations and substations;</li> <li>10. Own demand systems of power plants and substations;</li> </ol>
Exam form	Written
Teaching/learning and examination requirements	<p>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.</p> <p>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.</p> <p>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</p>

	<p>moment of completion of the final exam, a period of 72 hours is allotted for checking and posting the results on the electronic platform.</p> <p>The teacher who taught the students in this discipline is not involved in the process of conducting the exam and checking the students' answers.</p> <p>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.</p>
<p>Scope of assessment criteria and procedure</p>	<p><b>CURRENT CONTROL</b></p> <p>Purpose: Determining and assessing the student's level of knowledge, practical skills, and competencies on course topics.</p> <p>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.</p> <p>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.</p> <p><b>MIDTERM CONTROL</b></p> <p>Purpose: Assessing the student's knowledge and practical skills and level of mastery of lecture material after completing the relevant section of the course.</p> <p>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.</p> <p><b>INDEPENDENT LEARNING</b></p> <p>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.</p> <p>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.</p> <p>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.</p> <p><b>FINAL CONTROL</b></p> <p>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.</p> <p>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</p>

	<p>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.</p> <p>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.</p>				
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

	<p>* 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.</p>
Recommended Literature	<p><b>Main literature:</b></p> <ol style="list-style-type: none"> <li>1. Allaev K-P., Siddikov I.X., Xdkimov MD-, Ibragimov R.I., Siddikov O.I., SHamsutdinov X-F- «Stansiya va podstansiyalarning elektr jixozlari».-O‘quv qo‘llanma, T.: Cho‘lpon nomidagi NMIU, 2014.</li> <li>2. Рожкова Л.Д. Карнеева Л.К. Чиркова Т.В.«Электрооборудование электрических станций и подстанций». Учебное пособие. 4-издания -М.:Издательский центр «Академия», 2007.</li> <li>3. Белецкий О.В., Лезнов С.И. «Обслуживание электрических подстанций». Учебное пособие. М.: энергоатомиздат, 1985.</li> <li>4. Быстрицкий Г.Ф. Кудрин Б.И. «Выбор и эксплуатация силовых трансформаторов». Учебное пособие для вузов. М.: Издательский центр «Академия», 2003.</li> <li>5. Неклепаев Б.Н. «Электрическая часть станций и подстанций». Учебное пособие. - М.: энергоатомиздат, 1986.</li> <li>6. Рожкова А.Д., Козулин Б.С. «Stansiya va podstansiyalarning elektr asbob-uskunalarini». Darslik- T.: O‘qituvchi,1986.</li> <li>7. Салов В.П. Справочник по ремонту, наладке и техническому обслуживанию электрооборудования. Учебное пособие. Издательство «Вента-2», 2007.</li> <li>8.Majidov T.Sh. Noanaviy va qayta tiklanuvchi energiya manbalari, o‘quv qo‘llanma,-T.: 2014.</li> <li>9.Taslimov A.D., Rasulov A.N., Usmonov E.G., Elektr taminoti, O‘quv qo‘llanma,-T.: “ILM ZIYO” nashriyoti, 2012.</li> <li>10.S. Orifjonov “Elektromagnetizm” T. “Noshir” 2011.</li> <li>11. A.A. Abdumalikov “Elektrodinamika” T. 2011.</li> <li>12.K.Аллаев,”Энергетика мира и Узбекистана”2009г.</li> </ol> <p><b>Additional literature:</b></p> <ol style="list-style-type: none"> <li>13. SH.Mirziyoev “Buyuk kelajagimizni mard va olijanob xalqimiz bilan birga quramiz” – T.: O‘zbekiston 2017.</li> <li>14. O‘zbekiston Respublikasini yanada rivojlantirish bo‘yicha Xarakatlar strategiyasi to‘g‘risida. - T.:2017 yil 7 fevral, PF-4947-sonli Farmoni.</li> <li>15. Чунихин А.А. электрических аппарат. –Учебное пособие , М: энергоатомиздат, 1988.</li> <li>16. Неклепанов Б.Н. , И.П. Крючков. электрическая часть станций и потстанций. –М: энергоатомиздат, 1989.</li> <li>17. Abduraxmanov K.P., Tigay O.E., Xamidov V.S. Комплекс мультимедийных лекций, o‘zbek va rus tillarida.</li> </ol> <p><b>Internet resources:</b></p> <ol style="list-style-type: none"> <li>18. www.gov.uz – O‘zbekiston Respublikasining hukumat portali.</li> <li>19. www.catback.ru – xalqaro ilmiy maqola va materiallar sayti.</li> <li>20. www.google.ru – xalqaro o‘quv materiallarini qidiruv sayti.</li> <li>21. www.ziynet.uz – milliy o‘quv materiallarini qidiruv sayti</li> </ol>