

<b>Name of subject</b>	<b>Power supply of industrial enterprises (ECTS 10)</b>
Subject/module code	SKET16710
Science taught semester (s).	6 <sup>th</sup> and 7 <sup>th</sup> semester
Responsible teacher	Kurbanov Abror, assistant.
Education language	Uzbek
Connection to the curriculum	Compulsory
Training hours (this including independent education)	<b>Total hours-300.</b> <b>Audience Training hours - 120.</b> Lecture training hour – 60 Laboratory training hour – 30 Practical training hour – 30 <b>Independent education -180 hours</b>
ECTS	10
The purpose and tasks of subject / learning outcomes	<p><b>The purpose of teaching the subject</b> is to teach students how to determine the cartogram of electrical loads and the conditional center of loads, select the number and power of power transformers at substations, use renewable energy sources in the power supply system of industrial enterprises, quality indicators of electrical energy, select cross-sectional areas of overhead and cable lines, short circuits in the power supply system, select electrical equipment, and automatic reactive power adjustment schemes in the power supply system of industrial enterprises.</p> <p><b>The task of the subject</b> is to help students build and select power supply schemes for industrial enterprises, analyze reactive power compensation issues, create a load map and determine the location of the main step-down substation, determine the cross-sectional areas of overhead and cable lines, and develop their professional competencies in the construction and design of power supply for industrial enterprises.</p> <p><b>Learning outcomes:</b></p> <ol style="list-style-type: none"> <li>1. Know the classification of electricity consumers and their types;</li> <li>2. Fully master the analysis of power quality issues;</li> <li>3. Know the graph of electrical loads and the calculation of electrical loads;</li> <li>4. Have the skills to calculate shop electrical networks and draw up system diagrams;</li> <li>5. Must fully master the theoretical foundations of the methods for selecting power transformers;</li> <li>6. Know the methods for selecting the cross-sections of conductors and cable cores;</li> <li>7. Have information on compensating for the reactive power deficit in the power supply system of industrial enterprises.</li> </ol>
Course content (topics)	<p><b>I. Main Theoretical Part (Lecture Sessions)</b></p> <p><b>Topic 1:</b> Introduction. History of development of energy in Uzbekistan, current state and prospects.</p> <p><b>Topic 2:</b> Grouping of consumers of electric energy of industrial enterprises.</p> <p><b>Topic 3:</b> Consumers of electric energy of industrial enterprises.</p> <p><b>Topic 4:</b> Electric load graphs of industrial enterprises and consumers.</p> <p><b>Topic 5:</b> Main quantities characterizing electric load graphs.</p> <p><b>Topic 6:</b> Design load in the power supply system and characteristic points for its determination.</p> <p><b>Topic 7:</b> Methods for determining the design load in the power supply system.</p> <p><b>Topic 8:</b> Method of regulated diagrams of design load.</p> <p><b>Topic 9:</b> Schemes of shop networks with voltage up to 1000V.</p> <p><b>Topic 10:</b> Protection of shop networks.</p>

**Topic 11:** Issues of compensation of reactive power in the power supply system of industrial enterprises.

**Topic 12:** Reactive power sources.

**Topic 13:** Cartogram of electrical loads and determination of the conditional center of loads.

**Topic 14:** Selection of the number and power of power transformers at substations.

**Topic 15:** Use of renewable energy sources in the power supply system of industrial enterprises.

**Topic 16:** Quality indicators of electric energy.

**Topic 17:** Asymmetry and non-sinusoidality of current and voltage waveforms

**Topic 18:** Power supply schemes of industrial enterprises. External and internal schemes.

**Topic 19:** Selection of cross-sectional areas of overhead and cable lines.

**Topic 20:** Selection of a cable line according to the condition of thermal resistance of short-circuit current.

**Topic 21:** Short circuit in a power supply system. Calculation of short-circuit currents.

**Topic 22:** Selection of electrical equipment.

**Topic 23:** Selection of electrical equipment for internal and external power supply systems.

**Topic 24:** Automatic reactive power adjustment schemes in the power supply system of industrial enterprises.

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

In laboratory exercises, students develop practical skills and competencies in various indicators of power supply processes of industrial enterprises, conducting experiments, calculating and drawing tables and graphs. The proposed topics are selected based on opportunities and conditions.

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

1. Study of electrical load graphs of industrial enterprises.
2. Study of automatic transfer switch (AVR) schemes of the reserve source.
3. Study of schemes of step-down substations of industrial enterprises.
4. Determination of the asymmetry coefficient of voltage and the displacement voltage of the neutral point.
5. Checking non-sinusoidal modes in the electrical networks of industrial enterprises and cities.
6. Symmetry of asymmetry loads of a three-phase network.
7. Compensation of reactive power.

## **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.

**The following topics are recommended for practical training:**

	<ol style="list-style-type: none"> <li>1. Calculation of the quantities characterizing the electrical load graphs.</li> <li>2. Calculation of the design load using the main and auxiliary methods.</li> <li>3. Determination of the amount of reactive power to be compensated.</li> <li>4. Construction of a cartogram of electrical loads and determination of the installation location of the BPP.</li> <li>5. Selection of the number and power of transformers.</li> <li>6. Calculation of the power of renewable energy sources in the power supply system of the enterprise workshop.</li> <li>7. Calculation of deviations and fluctuations of the quality indicators of electrical energy.</li> <li>8. Calculation and selection of cross-sectional areas of overhead and cable lines.</li> <li>9. Calculation of grounding devices.</li> <li>10. Calculation and selection of parameters of electrical appliances.</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. General issues of power supply of industrial enterprises.</li> <li>2. Quality indicators of electric energy.</li> <li>3. Methods of determining electrical load graphs.</li> <li>4. Power supply schemes of industrial enterprises.</li> <li>5. Selection of power transformers.</li> <li>6. Selection of voltage in the power supply system of industrial enterprises.</li> <li>7. Methods of selecting transmission cables.</li> <li>8. Selection of electrical appliances, insulators and current-carrying parts (based on short-circuit current).</li> <li>9. Issues of reactive power compensation.</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 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>
Scope of assessment criteria and procedure	<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 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</p>

	<p>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
	* 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	<p><b>Main literature:</b></p> <ol style="list-style-type: none"> <li>1. Steven W.Blume. Electric Power System Basics. USA.: Wiley – Interscience A John Wiley&amp;Sous, INC Publication, 2007, 260 p</li> <li>2. Липкин Б.Ю., "Электроснабжение промышленных предприятий и установок", Учебник. -М.: "Высшая школа", 1980.</li> <li>3. Кудрин Б.И., Электроснабжения промышленных предприятий. Учебник. -М.: Интермет Инжиниринг, 2005.</li> <li>4. Qodirov T.M., Alimov X.A., «Sanoat korxonalarining elektr ta'minoti», O'quv qo'llanma,ToshDTU. –T.:2006.</li> <li>5. Qodirov T.M., Alimov X.A., Rafiqova G.R., Sanoat korxonalari va fuqoro binolarining elektr ta'minoti. O'quv qo'llanma. ToshDTU. – T.:2007.</li> <li>6. Taslimov A.D., Rasulov A.N., Usmonov E.G., Elektr ta'minoti. O'quv qo'llanma. Ilm-ziyo. –T.:2012</li> </ol> <p><b>Additional literature:</b></p> <ol style="list-style-type: none"> <li>7. O'zbekiston Respublikasining yanada rivojlantirish bo'yicha Xarakterlar strategiyasi to'g'risida.-T.:2017 yil 7 fevral, PF-4947-sonli Farmoni.</li> <li>8. Конюхова Е.А., Электроснабжение объектов: Учебное пособие. -М.: Издательство «Мастерство»; Высшая школа, 2001.</li> <li>9. Ополева Г.Н., Схемы и подстанции электроснабжения: Справочник: Учебное пособие. - М.: ФОРУМ: ИНФРА-М, 2006.</li> <li>10. Гулямов Б.Х., Салиев А.Г., Ташпулатов Б.Т., Тешабаев Б.М., Правила устройства электроустановок. Узгосэнергонадзор. -Т.: 2007.</li> <li>11. Аллаев К.Р., Энергетика мира и Узбекистана. Аналитический обзор. -Т.: Издательство «Молия», 2007.</li> <li>12. Аллаев К.Р., Электроэнергетика Узбекистана и мира. -Т.: «Фан ва технология», 2009.</li> </ol> <p><b>Internet resources:</b></p> <ol style="list-style-type: none"> <li>13. <a href="http://www.ziyonet.uz">www.ziyonet.uz</a> – national educational materials search site.</li> <li>14. <a href="http://www.gov.uz">www.gov.uz</a> – Government portal of the Republic of Uzbekistan.</li> <li>15. <a href="http://www.google.com">www.google.com</a> – international educational materials search site.</li> <li>16. <a href="http://www.energystrategy.ru">www.energystrategy.ru</a> – “Energy Policy and Strategy” information portal</li> <li>17. <a href="http://www.twirpx.com">www.twirpx.com</a> – international educational materials search site.</li> </ol>
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