Name of subject	Operation, repair and testing of electrical machines (ECTS 10)
Subject/module code	EMETS24510
Science taught semester (s).	4th and 5th semesters
Responsible teacher	Khudoyberdiev Umid lecture.
Education language	Uzbek
Connection to the curriculum	Elective
Training hours (this including independent education)	**Total hours-300** **Audience Training hours - 120** Lecture training hour – 60 Laboratory training hour – 24 Practical training hour – 36 **Independent education -180 hours**
ECTS	10
The purpose and tasks of subject / learning outcomes	**The purpose of teaching the course** is to enable students to understand the fundamental concepts and definitions related to the operation, testing, and repair of electrical machines, to develop theoretical and practical skills in the heating and cooling systems of electrical machines, to apply the acquired knowledge in practical settings, and to foster the ability to address and solve various problems and challenges within the field. **The objectives of the course** are to provide students with knowledge of the systems involved in the operation, testing, and repair of electrical machines, the functions of electrical machines and electronic devices, their development history and future prospects, and their role in enterprises across various sectors of the national economy. Additionally, it aims to cultivate and enhance critical thinking skills for operational practices in industrial enterprises, train students to articulate their ideas, reflections, and conclusions in a well-founded and clear manner, and develop their ability to apply these skills effectively in practical contexts. **Learning outcomes:** 1. Study the regulatory documents of the higher education system and the organization of the educational process within the credit-module system. 2. Learn higher education technologies and interactive teaching methods. 3. Study the theoretical concepts of the heating and cooling systems of electrical machines. 4. Acquire practical skills to adapt to studying in the credit-module system of higher education. 5. Master knowledge of the development statistics of the field globally and in our country. 6. Analyze the role of the heating and cooling systems of electrical machines in production processes. 7. Be able to analyze the classification and components of the heating and cooling systems of electrical machines. 8. Gain the ability to study and analyze the main processes of the heating and cooling systems of electrical machines.
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions)** **Topic 1:** Introduction to the course on the operation, repair, and testing of electrical machines. Determining the constructive execution of electrical machines. **Topic 2:** Criteria for selecting electric motors and transformers. Selection based on current type, power, and operating mode. **Topic 3:** Organization of electrical assembly works.

Topic 4: Drying of electrical machine and transformer cores.
Topic 5: Assembly of electrical machines.
Topic 6: Assembly of transformers.
Topic 7: Adjustment works during commissioning.
Topic 8: Composition and operation of the inspection system.
Topic 9: Inspection of electrical machines.
Topic 10: Inspection of transformers.
Topic 11: Technical maintenance of electrical machines.
Topic 12: Causes and types of wear in electrical machines.
Topic 13: Selection of protection for electrical machines.
Topic 14: Measurement of insulation resistance and testing its electrical strength.
Topic 15: Selection of protection for transformers.

II. Instructions and recommendations for organizing laboratory exercises.

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

Recommended topics for laboratory work:

1. Testing of phase rotor asynchronous motors.
2. Methods for measuring slip.
3. Experimental determination of transient parameters of synchronous generators.

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:

1.Calculate the change in motor rotation frequency when the voltage applied to the anchor core varies.
2.Determine the capacitor bank size when the power factor value increases up to 0.95%.
3.Calculate the starting characteristics of an asynchronous motor.
4.Select an efficient transformer for consumers with active-inductive load characteristics.
5.Determine the cross-sectional area of the wire for long-term loading.
6. Determine the starting torque, starting current, and maximum torque when additional resistance is introduced into the rotor circuit.
7. Analyze the operational characteristics of direct current.
8. Analyze the operational characteristics of electrical machines.

IV. Coursework instructions and recommendations

The following topics are recommended for the course project:

1. Accounting for the set of resistances in starting a phase-rotor asynchronous motor and adjusting its speed.
2. Selection of a synchronous motor for an electromechanical system and accounting for switching devices.
3. Designing a sequentially excited constant current motor for an electromechanical system.

	4. Selection of an asynchronous motor for an electromechanical system and accounting for switching devices. **V. 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. **Recommended topics for independent study:** 1.Faults encountered during the operation of transformers. 2.Analysis of the operating characteristics of asynchronous motors. 3.Analysis of the operating modes of asynchronous generators. 4.Analysis of the operating modes of synchronous compensators. 5.Adjustment of the speed of a phase rotor asynchronous motor. 6.Operating mode of a permanent magnet alternating current motor. 7.Operation of alternating current tachogenerators. 8.Operation of synchronized synchronous machines. 9.Analysis of the operating characteristics of asynchronous motors. 10.Faults encountered during the operation of transformers.
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. J.S. Alimov, N.B. Pirmatov. Elektr mashinalari Texnika oliy o‘quv yurtlarining «Elektr texnikasi, elektr mexanikasi va elektr texnologiyalari» yo‘nalishi talabalari uchun darslik. O‘zbekiston faylasuflari milliy jamiyati nashriyoti toshkent – 2011.
2. Тихомиров П.М. Расчет трансформаторов, *«ЭНЕРГИЯ» МОСКВА.*
3. И.П.Копылов, Проектирование электрических машин, учебник, МОСКВА, «ЮРАЙТ» , 2011.
4. Л.Г. Петрова, М.А. Потапов, О.В. Чудина. Электротехнические материалы учебное пособие, Москва 2008

Internet resources:

5.www.catback.ru – International scientific articles and materials website.
6.www.google.ru – International educational materials search website.
7.www.ziyonet.uz – National educational materials search website.