Name of subject	**Operation of electrical machines and transformers (ECTS 10)**
Subject/module code	EMTE24510
Science taught semester (s).	4th and 5th semester
Responsible teacher	Khudoyberdiev Umid, assistant
Education language	Uzbek
Study to the program connection	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.
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 course of Operation of electrical machines and transformers, students are evaluated on a 100-point system. Of these, 50 points are allocated to the current and intermediate results (60% of 50 points are current control, independent study and 40% are intermediate control), and 50 points are allocated to the final control results. 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. 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.