Name of subject	Electrical mechanics (ECTS 4)
Subject/module code	ELMEX2304
Science taught semester (s).	3rd semester
Responsible teacher	Saodullayev Abror Saypullayevich
Education language	Uzbek
Study to the program connection	Elective
Training hours (this including independent education)	**Total hours-120.** **Audience Training hours - 48.** Lecture training hour – 24 Laboratory training hour –0 Practical training hour – 24 **Independent education -72 hours**
ECTS	4
The purpose and tasks of subject / learning outcomes	**The purpose of teaching this subject:** The aim of the course is to teach students the structure and principles of operation of Electrical mechanics, their selection, operation, analysis of the physical processes occurring in them, calculation of the energy efficiency of Electrical mechanics, and formation and development of the design thinking of Electrical mechanics, teaching them to clearly state their opinions and conclusions in a well-founded manner, and to develop the skills to apply them in practice. **The task of the subject** is to teach students how to construct switching circuits for Electrical mechanics and determine their parameters, calculate and analyze the characteristics of Electrical mechanics, evaluate various operating modes of Electrical mechanics, control Electrical mechanics and adjust their speeds; design Electrical mechanics, and teach them the basic criteria for increasing and ensuring the efficiency of Electrical mechanics. **Learning outcomes:** 1.The student studies the nature of electromechanical phenomena in nature and technology of Electrical mechanics through the fundamental concepts of the science of Electrical mechanics. 2.The student studies the structure, operating principle, applications and characteristics of transformers. 3.The student studies the structure, operating principle, applications and characteristics of alternating current machines. 4.The student studies the structure, operating principle, applications and characteristics of direct current machines.
Course content (topics)	**I. Main theoretical part (Lecture)** **Topic 1:** Physical processes occurring in transformers. Magnetic cores of transformers and the structure of magnetic cores. Electromagnetic processes occurring in no-load and short-circuit modes of the transformer. **Topic 2:** EYUK and currents in transformer windings. Conversion of electrical parameters of the secondary winding of a transformer to the number of windings of the primary winding. Transformer T-shaped switching schemes and vector diagrams. **Topic 3:** Transformatorning tashqi tavsifi. Kuchlanishni rostlash. Transformator chulg‘amlari ulanish guruhlari. Parallel ulash shartlari. **Topic 4:** Parts and diagrams of the stator winding of alternating current machines. Magnetic motive forces (MMF) and magnetic fields. Pulsating, elliptical and circular rotating magnetic fields. **Topic 5:** Types of asynchronous machines, their structure and operating principle. Operating modes of an asynchronous machine. **Topic 6:** Vector diagrams of an induction machine. Energy

diagram of an induction machine. Electromagnetic (rotating) torque and mechanical characteristics of an induction machine.

Topic 7: Description of the operation of an induction motor. Starting an induction motor. Adjusting the rotation frequency of an induction motor. Induction generator, electromagnetic processes in it and their characteristics.

Topic 8: Modern series and special types of induction machines. Induction frequency converter.

Topic 9: Types of synchronous generators, structure and operating principle of synchronous machines. Types of excitation of synchronous generators. Armature reaction.

Topic 10: Parallel connection of a synchronous machine to an electrical network. Synchronization methods. Structure and principle of operation of a synchronous motor. Operating characteristics of a synchronous motor.

Topic 11: DC machine. The structure of DC machines and the principle of operation as generators. Characteristics of DC generators.

Topic 12: The structure of DC motors and physical processes in motors. Starting DC motors. Methods of adjusting the speed of DC motors.

II. Instructions and recommendations for practical training

The department will develop instructions and recommendations for organizing practical training. In it, students will further enrich the knowledge and skills they have acquired on the main lecture topics through practical problems and cases. It is also recommended to consolidate students' knowledge based on textbooks and manuals, use handouts, increase students' knowledge by publishing scientific articles and theses, solve problems, prepare presentations and visual aids on topics, use regulatory legal documents, etc.

Recommended practice topics:

1.Determination of the main parameters of a single-phase toroidal transformer;

2.Determination of the connection group of single- and three-phase transformer windings. Determination of the parameters of single-phase toroidal and Scott transformers for short-circuiting and short-circuiting;

3.Determination of the voltage drop of a transformer operating with a load. Determination of the parameters of autotransformers;

4.Check the conditions for parallel connection of transformers;

5.Starting an asynchronous motor using an additional resistance;

6.Determination of the parameters of a repulsion electric motor;

7.Solving problems related to methods for adjusting the rotation frequency of an asynchronous motor. Determination of the parameters of capacitor electric motors;

8.Calculation of the capacitances of the working and starting capacitors for connecting a three-phase asynchronous motor to a single-phase network;

9.Construction of the adjustment characteristic of a synchronous generator. Construction of the external characteristic of a synchronous generator;

10.Construction of the U-shaped characteristic of a synchronous generator. Construction of the angular characteristic of a synchronous generator;

11.External characteristics of DC generators;

12.Calculation of parameters of multifunctional DC motors Calculation of mechanical characteristics of an DC motor;

	III. 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.Transformers by operating modes. 2.Types of special transformers. 3.General issues of alternating current machines. 4.Special asynchronous machines. 5.Special synchronous machines. 6.Special DC machines. 7.Calculation of the main parameters of the transformer based on experimental data. 8.Construction of a characteristic of the transformer in the case of sudden and short-circuit operation; 9.Construction of an external and adjusting characteristic of the transformer; 10.Calculation of the useful efficiency of the transformer depending on its power; 11.Checking the conditions for parallel connection of transformers; 12.Starting an asynchronous motor using additional resistance; 13.Determination of the operating characteristics of an asynchronous motor using a circular diagram of currents; 14.Accurate calculation of the mechanical characteristics of an asynchronous motor; 15.Calculation of the working and starting capacitor capacities for connecting a three-phase asynchronous motor to a single-phase network; 16.Construction of the Potye diagram of a synchronous generator; 17.Construction of the adjustment characteristic of a synchronous generator; 18.Calculation of power losses in DC machines; 19.Switching in DC machines; 20.Determination of the main parameters of an DC motor;
Student assessment	Assessment of student knowledge is based on the mastery of the teaching material during the semester and final control (tests, assignments, written and oral work results). During the course of Electrical Machines, students are evaluated on a 100-point system. Of these, 50 points are allocated to the current and intermediate results (60% of the 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.Salimov J.S., Pirmatov N.B. Elektr mashinalari.– T.: O'zbekiston faylasuflari milliy jamiyati nashiryoti, 2011. –408 b. 2.Mustafakulova G.N., Toirov O.Z., Bekishev A.E. Elektr mashinalari. Toshkent.: Tafakkur avlodi. 2020. 191 b. 3.Majidov S. Elektr mashinalari va elektr yuritma. - T.: O'qituvchi, 2002. -358 b. 4.S. K. Sahdev/Electrical Machines/ © Cambridge University Press 2018 5.Testing of Power Transformers under participation of ° Carlson Ake Jitka Fuhr Gottfried Schemel Franz Wegscheider 1st Edition published by Pro Print GmbH, Düsseldorf ISBN 3-00-010400-3-2003. 6.Alimxodjayev K.T., Pirmatov N.B., Ziyoxodjayev T.I. Elektr mashinalari.- T.: "Fan va texnologiya", 2018. -344 b. 7.Alimxodjayev K.T., Pirmatov N.B., Ziyoxodjayev T.I., Mustafakulova G.N. Elektr mashinalari va transformatorlarning ekspluatatsiyasi. - T.: "Fan va texnologiya", 2019. -240 b. 8.Копылова И.П. Электрические машины: Учебник для бакалавр – Москва:. Юрайт, 2012. – 675 с. 9.Иванов – Смоленский А.В. Электрические машины. В 2-х т. Учебник для вузов.– М.: Изд–воМЭИ, 2004. Том. 1 – 652 с, Том 2 – 532 с. 10.Salimov J.S., Pirmatov N.B., Bekchanov B.E. Transformatorlar va avtotransformatorlar. T.: "VEKTOR-PRESS", 2010.-224 b. 11.N.B.Pirmatov, A.S.Saodullayev, A.Y.Bekishev, N.A.Qurbonov «Elektr mashinalari» o'quv qo'llanma O'zbekiston Respublikasi Oliy va o'rta-maxsus ta'lim vazirligi. – Toshkent: «ZEBO PRINT» nashriyoti. 2022.-197 b. 12.A.Saodullayev, U.Mirzayev «Elektr mashinalari fanidan tajriba mashg'ulotlarini bajarishga oid uslubiy ko'rsatma» Jizzax-2022. JizPI nashriyoti, 60 b. **Additional literature:** 13.Mirziyoyev Sh.M. Erkin va farovon, demokratik O'zbekiston davlatini birgalikda barpo etamiz. O'zbekiston Respublikasi Prezidentining lavozimiga kirishish tantanali marosimiga bag'ishlangan Oliy Majlis palatalarining qo'shma majlisidagi nutqi. – T.: "O'zbekiston" NMIU, 2016. – 56 b. 14.Mirziyoyev Sh.M. Qonun ustuvorligi va inson manfaatlarini ta'minlash – yurt taraqqiyoti va xalq farovonligining garovi. O'zbekiston Respublikasi Konstitusiyasi qabul qilinganining 24 yilligiga bag'ishlangan tantanali marosimdagi ma'ruza 2016 yil 7 dekabr. – T.: "O'zbekiston" NMIU, 2016. – 48 b. 15.Mirziyoyev Sh.M. Buyuk kelajagimizni mard va olijanob xalqimiz bilan birga quramiz. – T.: "O'zbekiston" NMIU, 2017. – 488 b. 16.O'zbekiston Respublikasini yanada rivojlantirish bo'yicha Harakatlar strategiyasi to'g'risida. – T.:2017 yil 7 fevral, PF-4947-

sonli Farmoni.

17.Pirmatov N.B., Yarmuxamyedova Z.A., Mustafakulova G.N. Elyektr mashinalari fanining transformatorlar qismi bo‘yicha kurs loyihasini bajarishga oid o‘quv-myetodik qo‘llanma. –T.: ToshDTU, 2012 – 117 b.

18.Кацман М.М. Сборник задач по электрическим машинам. Учеб. Пособие для вузов. –Москва.: – Издательский центр «Академия». 2012. –154 с.

19.Mustafakulova G.N., Toshev Sh.E. Elektr mashinalari fanidan laboratoriya mashg‘ulotlarini bajarish uchun metodik ko‘rsatma. –T.: TDTU, 2015. – 45 b.

20.Pirmatov N.B., Zayniyeva O.E. Elektromexanika (Elektr mashinalari) fanidan masalalar to‘plami. O‘quv qo‘llanma. –T.: TDTU, 2004. – 75 b.

Internet resources:

21.www.ziyonet.uz

22.http://dhes.ime.mrsu.ru/studies/tot/tot_lit.htm;

23.http://rbip.bookchamber.ru/description.aspx?product_no=854;

24.http://energy-mgn.nm.ru/progr36.htm