Name of subject	Fundamentals of Electrical Engineering (ECTS 10)
Subject/module code	EYUA16710
Science teachable semesters	6th and 7th semesters
Attached teacher	Kushakov Gulmurod Adilovich Senior teacher
Education language	Uzbek
Connection to the curriculum	Compulsory
Study hours (including independent learning)	**Total hours – 300.** **Auditory training hours - 120.** Lecture hours - 60 Laboratory study hours - 30 Practical study hours – 30 **Independent education -180 hour**
ECTS	10
and objectives of science / learning outcomes	**The goal of firing a gun is** to "Electricity" The main subjects of the bachelor's degree program "Electrical Engineering, Electrical Mechanics and Electrical Technologies" are the general physical and electrical mechanical properties of electromechanical systems, as well as the determination of the power of the power elements of an electric drive and the study of its energetics, providing a level of knowledge appropriate to the profile of the field. **The task of the subject** is to teach the role of electricity in the rise of modern industry, in solving urgent problems in the development of the national economy of the Republic, in developing the productive forces of the community, and in the production of competitive and high-quality products. **Learning outcomes:** 1. Study the history and prospects of the development of the electric propulsion system. 2. To become familiar with the role and socio-economic significance of electricity in society. 3. Study of the state policy in the electric power sector, as well as its development trends and prospects in the country and the world. 4. Study the basic concepts and principles of electrical engineering. 5. Economic assessment of the competitiveness of traditional and unconventional methods of production through electric propulsion. 6. To have a complete understanding of the equipment and devices of electrical installations. 7. Possess knowledge and skills in the basics of electrical engineering.
Course content (topics)	**I. Home theoretical part (Lecture)** **Topic 1.** History of the development of science. Mechanics of electrical engineering. Basic concepts of electrical engineering. Definition of electrical engineering. General structure of electrical engineering **Topic 2.** Calculation scheme of an electric drive. Standard kinematic scheme of mechanisms. Fundamentals of control of electric drives **Topic 3.** Motion of an electric motor. Steady state of motion of an electric motor. Mechanical equation of an electric motor, resistance moments, motor load connection systems **Topic 4.** Electromechanical characteristics of a DC motor with independent starting winding. Dynamic model of a DC motor. **Topic 5.** Starting, braking and reversing a self-propelled DC motor. DC motor control **Topic 6.** Adjusting the speed of a self-starting AC motor by connecting additional resistance to the armature circuit. **Topic 7.** Adjusting the coordinates of electric drives with

	independently excited DC motors by changing the voltage in the armature circuit. (GD, TU-D system) Thermal model of a DC motor **Topic 8 .** Electromechanical characteristics of a series-wound AC motor. **Topic 9.** Electromechanical characteristics of an asynchronous motor. **Topic 10.** Starting, braking and reversing an asynchronous motor. AC motor control **Topic 11.** Adjusting the speed of an asynchronous motor by connecting additional resistances. Brushless direct drives **Topic 12.** Adjusting the coordinates of an asynchronous motor electric drive by changing the voltage. **Topic 13.** Adjusting the coordinates of the electric drive by pulsed control of the rectified current in the rotor circuit of an asynchronous motor. **Topic 14.** Adjusting the speed of an asynchronous motor by changing the number of pole pairs. **Topic 15.** Adjusting the speed of an asynchronous motor by changing the network frequency. Position sensors and speed measurement in electric drives **Topic 16.** Electromechanical characteristics of a synchronous motor **Topic 17.** Starting, braking and reversing a synchronous motor. **Topic 18.** Synchronous motor reactive power compensator. **Topic 19.** Electromechanical transients in open-system electrical drives. **Topic 20.** Transients in step rheostat start of a linear variable speed motor. General control scheme, direct speed control and speed regulator dimensions, cascaded control of current, speed and position and dimensions of related regulators. **Topic 21.** Starting process, reversing, braking and transient process during speed changes. **Topic 22.** Mechanical characteristics of a linear variable motor with a control signal based on an aperiodic law. **Topic 23.** Electric propulsion energy. Energy performance of electric propulsion. Energy losses in transient mode. Main factors for selecting electric propulsion motors. **Topic 24.** Checking motors for direct overheating. **Topic 25.** Load diagrams of electrical drives. **Topic 26.** Selection and testing of electric motors. Energy saving using electric drives. **Topic 27.** Coordinate-controlled direct current electric drive system. **Topic 28.** Coordinate-controlled alternating current asynchronous electric drive system. **Topic 29.** Coordinate-controlled alternating current synchronous electric drive system. **Topic 30.** Electromechanical transients of closed-system electrical drives. **II. Guidelines and recommendations for organizing laboratory exercises.** In laboratory classes, students develop practical skills and competencies in various indicators of processes in the fundamentals of electricity, conducting experiments, calculating and drawing tables and graphs. The proposed topics are selected based on opportunities and conditions. **Suggested topics for laboratory work:** 1. Familiarity with technical safety rules and laboratory equipment when performing laboratory work. 2. Determine the torque of a DC electric motor during operation. 3. Research the static characteristics of a separately excited AC

motor.

4. Investigating the static characteristics of a self-starting AC motor when the magnetic flux changes.

5. Research the characteristics of a self-driven AC motor in braking mode.

6. Study of the static characteristics of a series-excited AC motor.

7. Study of the static characteristics of a series-excited AC motor when the magnetic flux changes.

8. Study of the static characteristics of a DC motor with an independent excitation winding in a "generator-motor" system.

9. Study of the static characteristics of a DC motor with independent excitation winding in the "TO'-O'TM" system.

10. Study of the static and tuning characteristics of the "Direct Start of an Asynchronous Motor" system.

11. Research the characteristics of the braking mode of the "direct start of an asynchronous motor" system.

12. Study of the static and tuning characteristics of the "Reactor Start-up of an Asynchronous Motor" system.

13. Study of the static and tuning characteristics of the "Thyristor Voltage Regulator-Asynchronous Motor" (TKRAD) system.

14. Research on the soft start characteristics of the "Thyristor Voltage Regulator-Asynchronous Motor" (TKRAD) system.

15. Study of the static and tuning characteristics of the "frequency converter-asynchronous motor" (CHU-AD) system.

III. Practical for training instructions and recommendations

The teacher's preparation for a practical session begins with studying the initial 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 session, as well as the amount of work that each student must perform.

Methodological guidelines are the teacher's main methodological document in preparing and conducting practical classes.

The goal of practical training is to understand theory and acquire skills. Its conscious application in educational and professional activities consists in developing the ability to confidently formulate one's own point of view.

Recommended practical topics:

1.Calculation of moments of inertia of mechanical parts of electric drives.

2. Bringing the moment of inertia of the electric drive to the motor axis.

3. Determining the optimal transmission parameters of mechanical transmissions.

4. Drawing up a mechanical calculation diagram of the mechanical part of the electric drive.

5. Calculation of the nominal values of the electric motor.

6. Calculation of natural and artificial static characteristics of DC motors with series resistance connected to the armature circuit; dynamic model of a DC motor.

7. Calculation of static characteristics of DC motors with parallel resistance connected to the armature circuit; DC motor control.

8. Calculation of natural and artificial static characteristics of AC motors with series and parallel resistance connected to the armature circuit.

9. Calculation of static characteristics of AC motors when the magnetic flux changes.

10. Calculate and construct the characteristics of reversing an AC motor.

	11. Calculation of the transient process of electrical drives with linear and curvilinear mechanical characteristics. 1 2. Taking into account electromagnetic processes in asynchronous motors. 13. Calculation of static and dynamic modes of synchronous motors. 14. Calculation of modes of synchronous motors. 15. Calculation and analysis of automated electrical processes controlled by microprocessors. **IV. Instructions and recommendations for coursework (project)** **The following topics are recommended for the course project:** 1. Calculation of the "generator-motor" system, selection of power elements, and construction of characteristics. 2. Calculation of the “TO'-O'TM” system, selection of power elements, and construction of characteristics. 3. Calculation of the electrical power of a metal-forming machine, selection of power elements, and construction of specifications. 4. Calculate the electrical power of a bridge crane trolley, select power elements, and build specifications. 5. Calculation of static and dynamic modes of the "Frequency converter-Asynchronous motor" system. 6. Selection of a quasi-frequency converter system for low-power crane mechanisms and calculation of mechanical and operational characteristics. 7. Selection of asynchronous motor power and calculation of operating characteristics for belt conveyors. 8. Select a modern microprocessor-based voltage converter for the pump unit to ensure smooth motor power and operation. 9. Selecting a synchronous motor for compressor drives and increasing its power factor. 10. Methods for adjusting the speed of a DC electric motor and choosing a control method that ensures reduction of power waste. **V. Independent study 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. Analysis of the elements of mechanical parts of electrical drives. 2. Bringing the moment of inertia of the electric drive to the motor axis. 3. Designing kinematic transmissions and determining optimal transmission parameters. 4. Characteristics of flywheel electric drives. 5. Group electrical operations analysis. 6. Individual electrical wiring analysis. 7. Determining the number of gears in the mechanical part of an electric drive. 8. Determine and use the nominal values of electrical equipment. 9. Analyze the mathematical representation of a DC motor.
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,	10 points	

	laboratory classes)			
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. Yusupbekov N.R., Muxamedov B.I., Gulyamov Sh.M. Texnologik jarayonlarni nazorat qilish va avtomatlashtirish. - Toshkent: O`qituvchi, 2011. -576b.

2. N.K. Yo‘ldoshev, N.R. Kadirxodjayeva “Ishlab chiqarish texnologiyalari” Toshkent — 2014

3. John J. Criag Mechanics and Control -Pearson Education International, 2013

4. Клим Ю.М. Типовые элементы систем автоматического управления. Учебное пособие для студентов учреждений среднего профессионального образования. -М: ФОРУМ : ИНФРА-М, 2004.-384с.

5. Москаленко В.В. Тизим автоматизированного управления электропривода» : -М.ИНФРА,2001. Шишмарев В.Ю. ТИПОВЫЕ элементы систем автоматичсского управления. Учебиик для сред.проф.образования. -М: Издат. «Академия», 2004 -304с.

6. Зимин Б.Н., Яковлев В.А. «Автоматическое управление электроприводами». М: высш.шк.1989г.

7. Башарин А.В. и др. «Управление электроприводами» Л: ВЫСШ.ШК 1982г.

8. Клюев В.И. и др. «Теория электропривода». - М: ВЫСШ.ШК 2002 г.

Additional literature:

9. 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. -56b.

10. O‘zbekiston Respublikasini yanada rivojlantirish bo‘yicha Harakatlar strategiyasi to‘g‘risida. – T.: 2017 yil 7 fevral, PF-4947 – sonli farmoni.

11.O.O. Xoshimov, SH.B. Umarov “Umumsanoat mexanizmlarining avtomatlashtirilgan elektr yuritmalari” Toshkent 2020.

12.Башарии А.В. «Примеры расчета автоматизированного электропривода на ЭВМ» Л:Машиностроение 1990 г.

13.Ломако М.В. «Микропроцессорное управление промышленных роботов» М:Машиностроение 1990 г.

14. Смирнова В.К. «Проектирование и расчет автоматизированных приводов» -М:Высш.шк 1990 г.

Internet sources:

17.www.lex.uz - National database of legal documents of the Republic of Uzbekistan.

18. www.ziyonet.uz - Education portal of the Republic of Uzbekistan.