

Fan name	Electrical Insulation and Cable Engineering (ECTS 5)
Subject/module code	EIKT2405
Science taught semester (s).	4 th semester
Responsible teacher	Akhmedov Abdurauf Abdug'ani o'g'li Senior teacher
Education language	Uzbek
Study to the program connection	Elective
Training hours (this including independent education)	Total hours - 150. Auditory training hours - 60. Lecture training hours - 30 Laboratory training hours - 15 Practical training hours - 15 Independent education -90 hours
ECTS	5
The purpose and tasks of subject / learning outcomes	The purpose of teaching the subject is to form a level of knowledge in students about electrical insulating materials and their types, their testing, classification of electrical insulating materials, physicochemical, mechanical and electrical properties of electrical insulating materials, the use of electrical insulating materials in the production of cable and conductor products and methods of testing electrical insulating materials, as well as the technology of manufacturing cable products based on educational standards and a set of basic technological operations, as well as the structural structures of cable products. The task of the subject is to provide students with in-depth training and analysis of electrical insulating materials used in the electrical engineering and cable industry, to thoroughly teach the main properties of electrical insulating materials, types, and testing methods used in the production of electrical insulating materials. Based on the knowledge gained, to select cables and determine the factors affecting their service life in various operating modes. Learning outcomes: 1. To have an idea of the basic terms and concepts of electrical insulation and cable technology, its goals and objectives, the ability to distinguish electrical insulation used in manufacturing enterprises from each other, and the reasons for their origin. 2. The student should know and be able to use electrical insulation and cable techniques and parameters, as well as methods for measuring electrical quantities. 3. The student must have the skills to use and design electrical insulation and cable equipment in manufacturing enterprises.
Course content (topics)	I. Main Theoretical Part (Lecture Sessions) Topic 1: Introduction. Development stages of power cables and information and communication technologies. Topic 2: Basic parts and terminology of cable products. General information about cables. Topic 3: Electrical insulation of cables. Dielectric permittivity and capacitor capacity in a constant and alternating electric field. Dielectric permittivity and their types. Equivalent dielectric replacement scheme. Polarization. Topic 4: Cable preparation technology. Dipole theory of polarization. Lorentz field and Clausius-Mossotti equation. Elastic and orientational polarization. Static polarization theory. Topic 5: City telephone cables . Dielectric as a medium of an electric field. Dielectric capacitance. Accumulation of charge in a dielectric Topic 6: Cable insulation wear. Study of polarization of dielectrics depending on the state of aggregation Topic 7: Physicochemical and mechanical properties of insulating

materials. Polarization and dipole moments of molecules. Experimental determination and theoretical assessment of the polarizability of atoms and ions. Dependence of dielectric properties on the structure of matter. Dielectric properties of ionic crystals. Dielectric properties of polymers and glasses.

Topic 8: Types of cable insulation. Electret effect in dielectrics. Methods of obtaining electrets. Properties of electrets. Piezoelectric and pyroelectric phenomena in dielectrics. Ferroelectrics. Passive dielectrics.

Topic 9: Coaxial cables with integral polyethylene insulation. The concept of dielectric losses. Types of dielectric losses. Causes of dielectric losses.

Topic 10: Semi-air polyethylene insulated coaxial cables.

The concept of dielectric losses in liquid dielectrics. Causes of dielectric losses in liquid dielectrics.

Topic 11: Low-frequency symmetrical cables with polyethylene insulation.

The concept of dielectric losses in gaseous dielectrics. Causes of dielectric losses in gaseous dielectrics.

Topic 12: Cable insulation. The concept of dielectric losses in solid dielectrics. Causes of dielectric losses in solid dielectrics.

Topic 13: Cable current conductor manufacturing technology.

General laws of the passage of electric current through a dielectric material. Current balance equation. The emergence of electrical conductivity in various dielectrics

Topic 14: Semiconductor materials. Reasons for the appearance of charge carriers in gaseous dielectrics. Mobility of charge carriers in gases. Volt-ampere characteristic. Breakdown of gaseous dielectrics

Topic 15: Magnetic materials. Causes of electrical conductivity in liquid dielectrics and their types. The process of breakdown of liquid dielectrics. The process of breakdown of single and multi-type liquid dielectrics.

Topic 16: Plastic insulated cable fittings. Fundamentals of the theory of conduction zones of solids.

Topic 17: Types of cables with plastic insulation. Causes of electrical conductivity in solid dielectrics and their types. The effect of iodine particles on the breakdown process of dielectrics. Theory of electrical conductivity. Electrical conductivity of polarized and non-polarized dielectrics

Topic 18: Rubber insulated power cables. Nature of ionic conductivity in solid dielectrics, nature of electronic conductivity in solid dielectrics, theoretical description of conductivity and diffusion, Nernst-Weinstein relationship

Topic 19: Cable types. Explanation of the phenomenon of puncture, types of puncture, breakdown mechanism of dielectric breakdown.

Topic 20: Hose cables. Types of discharges present in solid, liquid and gaseous dielectric materials and their physical nature

Topic 21: Mine cables. Piercing of gaseous dielectrics. Use of gaseous dielectrics as insulation

Topic 22: Special cables and wires. The process of piercing liquid dielectrics. The process of piercing single and multi-layer liquid dielectrics

Topic 23: Cables with various applications and similar. Study of existing theories of liquid dielectric breakdown process

Subject 24: Types of insulated wires. Breakdown and breakdown of solid dielectrics. Theoretical laws of breakdown and breakdown mechanism. Theory of breakdown. Theoretical laws of electrical aging.

Topic 25: Communication cables. Explanation of the phenomenon of puncture, its mechanism and cause of occurrence

Topic 26: Fiber optic cables. Explanation of the phenomenon of

puncture, its mechanism and cause.

Topic 27: Telephone communication cables. Explanation of the phenomenon of perforation, its mechanism and cause of occurrence

Topic 28: Warranty period and cable service life. Basic rules of theory.

Topic 29: Cable electrical calculation. Basic rules of the theory

Topic 30: Cable environmental thermal resistance. Concepts of electrical and thermal aging of dielectrics, the nature of the phenomenon, the causes of aging of dielectrics.

II. Instructions and recommendations for organizing laboratory exercises.

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

Recommended topics for laboratory work:

1. Calculation of surface electrical resistance of electrical insulating materials.

2. Calculation of the volume electrical resistivity of electrical insulating materials.

3. Calculation of the electrical capacitance of electrical insulating materials.

4. Calculation of the electrical strength of solid electrical insulating materials.

5. Calculation of mechanical parameters of electrical insulating materials.

6. Calculation of the dielectric constant of electrical insulating materials.

7. Dielectric conductivity calculation of electrical insulating materials.

8. Cable electricity bill.

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 cable wire strength parameters.

2. Calculation of the conductive core and protective coatings.

3. Calculation of the mass of materials, structural calculation of cable product elements.

4. General information about calculating heating cables, calculating the capacity of drums.

5. Types of tests. Various, acceptance, control, preventive, non-electrical electrical tests of electrical insulating materials.

6. Calculating the accuracy of measurements. Studying the classification and marking of capacitors. Calculating the capacitance, charge, energy, and insulation resistance of capacitors.

7. Electric discharges.

8. Study of various insulators.

	IV. 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. Classification of electrical insulating materials (dielectrics) 2. Electrical insulating materials used in the cable industry 3. Electrical insulating materials used in the group of cable and conductor products (high voltage) 4. Electrical insulating materials used in high-voltage insulation 5. Solid dielectrics and their uses 6. Liquid dielectrics and their uses 7. Gaseous dielectrics and their uses 8. Physical properties of electrical insulating materials 9. Chemical properties of electrical insulating materials 10. Mechanical properties of electrical insulating materials 11. Electrical properties of electrical insulating materials 12. Sample testing of electrical insulating materials 13. Control testing of electrical insulating materials 14. Certification testing of cable and wiring products 15. Fire testing of electrical insulating materials 16. Preventive testing of electrical insulating materials 17. Acceptance of electrical insulating materials - assignment test 18. Electrical testing of electrical insulating materials 19. Non-electrical testing of electrical insulating materials 20. Mechanical testing of electrical insulating materials 21. Modern technological refrigeration equipment 22. Modern technological turning equipment 23. Modern technologically efficient equipment 24. Modern technological equipment for applying metal shell 25. Modern technological equipment for wire production 26. Modern technological equipment for the production of high-voltage electric cables with cross-linked polyethylene insulation 27. Modern materials for the production of cable products 28. Modern materials for the manufacture of capacitors 29. Modern materials for the manufacture of insulators
Student assessment	Assessment of student knowledge is based on the mastery of teaching materials (tests, assignments, written and oral work results) during the semester and final examination. During the Electrical Insulation and Cable Engineering course, students are assessed on a 100-point scale. Of these, 50 points are allocated to the current and intermediate results (60% of the 50 points are current control, independent study and 40% intermediate control), and 50 points are allocated to the final control result. Students whose total current and intermediate scores are 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. A.R. West . R.H. Mitchell . P. Shiv Halasyamani M. Kunz & I.D. Brown . A. Safari, R.K. Panda, V.F. Janas. Dielectric Materials. Chemistry 754, 2002. 2.T.K. Basak. Electrical engineering materials. New Age Intenational, Nil edition. USA, 2009. 3. Ahmedov A.Sh, Kurbanbayeva D.I. Kabel texnikasining nazariy asoslari. O'quv qo'llanma,- Toshkent: TDTU, 2015. 4.Ahmedov A.Sh. Elektr texnika materiallar. O'quv qo'llanma, - Toshkent: TDTU, 2006. 5. Electrical Power Cable Engineering Third Edition By William Thue-watermark. © 2012 by Taylor & Francis Group, LLC CRC Press is an imprint of Taylor & Francis Group, an Informa business Additional literature: 4. O'zbekiston Respublikasi Prezidentining 2017 yil 20 apreldagi "Oliy ta'lim tizimini yanada rivojlantirish chora-tadbirlari to'g'risida"gi 2909-sonli Qarori. 5. O'zbekiston Respublikasi Prezidentining 2017 yil 27 iyuldagi "Oliy ma'lumotli mutaxassislar tayyorlash sifatini oshirishda iqtisodiyot sohalari va tarmoqlarining ishtirokini yanada kengaytirish chora-tadbirlari to'g'risida"gi 3151-sonli Qarori. 6. Mirziyoyev SH.M. Buyuk kelajagimizni mard va olijanob xalqimiz bilan birga quramiz. – T.: "O'zbekiston" NMIU, 2017. - 488 b. 7. Mirziyoyev SH.M. Tanqidiy tahlil, qat'iy tartib-intizom va shaxsiy javobgarlik - har bir rahbar faoliyatining kundalik qoidasi bo'lishi kerak. – T.: "O'zbekiston" NMIU, 2017. - 104 b. 8. Mirziyoyev SH.M. Erkin va farovon, demokratik O'zbekiston davlatini birgalikda barpo etamiz. – T.: "O'zbekiston" NMIU, 2017. - 56 b. 9. Mirziyoyev SH.M. Qonun ustuvorligi va inson manfaatlarini ta'minlash - yurt taraqqiyoti va xalq farovonligining garovi. – T.: "O'zbekiston" NMIU, 2017. - 48 b. 10. Пешков И.Б. Кабели и провода. Основы кабельной техники. учебник для студ. высш. учеб. М.: Энергоиздат, 2009; 11. Леонов В. М., И. Б. Пешков, И. Б. Рязанов, С.Д.Холодный Основы кабельной техники: учебник для студ. высш. учеб. М.: Издательский центр «Академия», 2006. Internet resources: 12. www.lex.uz – National database of information on legal documents of the Republic of Uzbekistan. 13. www.ziyonet.uz – national educational materials search site. 14. www.gov.uz – Government portal of the Republic of Uzbekistan. 15. www.google.com – international educational materials search site. 16. www.energystrategy.ru – "Energy Policy and Strategy" information portal 17. www.twirpx.com – international educational materials search

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