Name of subject	Mathematical problems of energy (ECTS 5)
Subject/module code	EMM2505
Science taught semester (s).	5th semester
Responsible teacher	Jalilov Urinbay Abdunayim ugli, senior teacher.
Education language	Uzbek
Study to the program connection	Elective
Training hours (this including independent education)	**Total hour - 150.** **Auditory training hours - 60.** Lecture training hour - 30 Practical training hour - 30 **Independent education -90 hour**
ECTS	5
Science goals and objectives / learning outcomes	**The goal of teaching science** is s to develop students' skills in understanding the mathematical problems of energy, the implementation of digital energy technologies in the power supply system. At the same time, it is to comprehensively study smart grids and digital substations in the power system.. **The task of the subject** is to comprehensively teach students about the mathematical issues of energy and its application in the power supply system, to develop skills in the use of digital devices in the process of automatic control and accounting of energy consumption in the power supply system, and to comprehensively teach all issues related to the basic concepts of digital energy, economic and technical calculations. **Learning outcomes:** 1. Learns to form a mathematical model (formulate equations and objective functions) for calculating and optimizing various states of electrical networks and systems, and to choose methods for solving mathematical problems in energy. 2. Will acquire skills in calculating and optimizing the states of simple electrical networks and systems in various ways. 3. Will acquire skills in calculating and optimizing the state of electrical networks and systems in various ways based on modern calculation tools and standard programs.
Course content (topics)	**I. Main Theoretical Part (Lecture Sessions)** **Topic-1.** Introduction. The task of science. **Topic-2.** Formulation of the equations of state of electrical systems in matrix form. Matrix representations of Ohm's and Kirchhoff's laws. **Topic-3.** Determinants. Their properties. Algebraic complements and minor matrices. **Topic-4.** Properties of square matrices. **Topic 5.** Block matrices. complex matrices. **Topic-6.** Application of graph theory to solving equations of state of electrical systems. **Topic 7.** Writing a system of linear equations in matrix form. **Topic-8.** Methods for solving linear equations of state of electrical systems. **Topic-9.** Improved Gaussian method. **Topic 10.** Calculating a system of linear equations using the iteration method. **Topic 11.** Methods for solving nonlinear equations of steady states of electrical systems. **Topic 12.** Methods for optimizing the modes and parameters of electrical systems.

	II. 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:** ● Formulate the basic laws for the switching scheme. ● Express the basic electrical engineering laws for DC and AC electrical circuits in matrix form. ● Operations on complex matrices. ● Formulate the switching scheme of three-phase electrical networks. ● Formulate linear node equations in matrix form. ● Solve a system of linear node equations by exact methods. ● Methods for approximate solution of a system of linear node equations. ● Formulate nonlinear node equations describing the state of electrical networks in matrix form. ● Solve nonlinear node equations by iteration methods. ● Solve node equations by the Newton-Raphson method. ● Solve linear programming problems graphically and graphically. ● Apply methods for solving linear programming problems in optimizing power transmission lines. ● Solving linear programming problems using the simplex method. ● Determining the probabilities of arbitrary electrical quantities falling into a given interval. ● Strength indicators of electrical system elements. **IV. 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. Fundamentals of matrix theory. Characteristics of matrices. Determinants. Properties of determinants. 2. Operations on matrices. Inverse matrix. 3. Basic laws of electrical circuits. 4. Methods of calculating electrical circuits used in electrical engineering (nodal potentials, contour currents, superposition). 5. Construction of nonlinear node equations representing the state of electrical systems. 6. Energy characteristics of generators of power plants. 7. Mathematical methods of unconditional and conditional optimization.
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 Networks and Systems 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. Электротехнический справочник: Т. 3. Производство, передача и распределение электрической энергии./Под общ. ред. профессоров МЭИ. – М.: Издательство МЭИ, 2004, 964 с. 2. Веников В.А.. Математические задачи энергетики.М.1987. 3. Гмурман Г.А.. Теория вероятностей и математическая статистика. М.: Статистика. 1988.-204с. 4. Фазылов Х.Ф. Т.Х.Насыров. Линейные расчетные модели сетей электрических систем. Тошкент: Фан. 1982.-96с. 5. Самарский А.А. Введение в численные методы. М.: Наука. 1987. 6. Коршунов Ю.М. Математические основы кибернетики. Учебн. пособие для ВУЗов. 3-е изд. Энергоатомиздат. 1987. 7. Сиддиков И.Х. и др. Математические задачи энергетики. Метод. указания. Ташкент, ТашГТУ, 1991., 2004. **Additional literature:** 8. Mirziyoyev Sh.M. Yangi O‘zbekistonda erkin va farovon yashaylik. –T.: “TASVIR nashriyot uyi”, – 2021.– 50 b. 9. Mirziyoyev Sh.M. Milliy taraqqiyot yo‘limizni qati’yat bilan davom ettirib yangi bosqichga ko‘taramiz .–T.:“O‘zbekiston”, 2017–592 b 10. Decree of the President of the Republic of Uzbekistan dated January 28, 2022 No. PF-60 “On the Development Strategy of New Uzbekistan for 2022-2026”. 11. Decree of the President of the Republic of Uzbekistan No. PF-220 dated 09.09.2022 “On additional measures for the introduction of energy-saving technologies and the development of small-capacity renewable energy sources”. 12. Пармонов А.Э., Сиддиков И.Х. «Гидроэнергетиканинг математик масалалари» фанидан маъруза матни. ТошДТУ, 2002. **Internet sources:** 13. www.ziyonet.uz – a search site for national educational materials. 14. www.gov.uz – Government portal of the Republic of Uzbekistan. 15. www.google.com – an international educational materials search

	site. 16. www.energystrategy.ru – information portal “Energy Policy and Strategy” 17. www.twirpx.com – a search site for international educational materials.