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, assistant.
Education language	Uzbek
Connection to the curriculum	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.
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	10 points	

	activity (in seminars, practical, 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. 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.