Name of subject	Theoretical Electrical Engineering (ECTS 9)
Subject/module code	NAZEL 13409
Science taught semester (s).	3rd and 4th semester
Responsible teacher	Nurullayev Orziqul Ubayevich, head teacher.
Education language	Uzbek
Connection to the curriculum	Compulsory
Training hours (this including independent education)	**Total hours-270.** **Audience Training hours - 108.** Lecture training hour – 48 Laboratory training hour – 30 Practical training hour – 30 **Independent education -162 hours**
ECTS	9
The purpose and tasks of subject / learning outcomes	**The purpose of teaching** the subject The goal of teaching science is to solve the problem of preparing future specialists, including the electromagnetic field, a form of matter, and the processes that occur in its various devices, methods of analysis, synthesis, and calculation of electric and magnetic fields. **The task of the subject** The task of the subject is to teach students the theory of electrical circuits and their analysis and synthesis. The task of the subject "Theoretical Electrical Engineering" is to teach its students: -elements of electrical circuits and their basic concepts -basic laws and calculation methods for the analysis of constant and alternating current circuits; -resonance phenomena, self-inductance and mutual inductance; -three-phase circuits, periodic non-sinusoidal currents in electrical circuits; -transient processes in linear electrical circuits; -basic laws and calculation methods for quadrupoles, electrical filters, circuits with scattered parameters; -the theory of nonlinear electrical circuits; -the theory of electromagnetic fields is aimed at mastering their analysis and synthesis **Learning outcomes:** 1. Constant current linear electric circuits and methods for their calculation are studied. 2. Electric current. Current density. Ohm's law. Electric energy and electric power. Formulation of topological equations of complex electric circuits based on Kirchhoff's laws. Equivalent transformation of circuits consisting of series, parallel and mixed connected elements 3. Single-phase sinusoidal current linear electric circuits are studied, they get acquainted with the effective and average values of sinusoidal current and learn to calculate them. 4. Three-phase circuits. They can explain the difference between three-phase electric circuits and 5. Non-sinusoidal periodic quantities. Non-sinusoidal current circuits. The concept of non-sinusoidal current. Fourier series. Transient processes in electric circuits. The concept of transient processes. Switching laws. Filters 6. Calculation of transient processes in nonlinear circuits. Electrostatic field. Image method. Capacitance absorption. Calculation of the electric field of a constant current. Calculation of the magnetic field of a constant current
Course content (topics)	**I. Main theoretical part (Lecture)**

	Topic 1: Introduction to the subject of "Theoretical Electrical Engineering".The role and importance of theoretical electrical engineering in modern science and technology and in production. **Topic 2:** Understanding electrical circuits and elements. Resistive, capacitive and inductive elements. Ohm's law. Law of electromagnetic induction. Voltage and current sources. Circuit and its topological forms. Calculation of resistance, capacitance and impedance of inductive circuit elements in alternating current circuits. **Topic 3:**Methods for calculating electrical circuits. Kirchhoff's laws. Calculation of simple electrical circuits. Circuits with elements connected in series, parallel and mixed. Calculation of complex electrical circuits. Methods of contour currents and node potentials. First-order circuits with a resistor and a capacitor connected to a current-voltage generator, determination of current or voltage during charging/discharging using a first-order differential equation . **Topic 4:** Sinusoidal current electrical circuits. Concept of sinusoidal current generation and electrical generators. Concepts of frequency, period, phase, initial phase and amplitude. Current voltage, effective (acting) and average values of e.u.k. Power in AC circuits, S, P and Q, current power, active and reactive average power, RMS value, apparent power, power factor **Topic 5:** Representation of sinusoidal currents and voltages with vectors and complex numbers.Power. Currents and voltages in circuits with resistors, inductances, and capacitances connected in series. Vector diagrams. Analysis of simple stationary alternating current circuits with resistive, capacitive, and inductive circuit elements using the complex method. **Topic 6:** Triangles of resistances and voltages. Voltage resonance. Currents and voltages in circuits with active resistance, inductive and capacitive elements connected in parallel. Triangles of resistances and currents. Current resonance. **Topic 7:** Inductively coupled circuits.Calculation of inductively coupled circuits. Matching, opposing, series and parallel connection of two coils. Concept of transformers. Ideal and real transformers, their useful working coefficient and vector diagram. **Topic 8:** Three-phase electrical circuits. Concept of three-phase electrical circuits. Connecting consumers in the "star" and "delta" configurations. Symmetrical and nsymmetrical systems.Rotating magnetic field. Concept of asynchronous machines. Measuring power in three-phase circuits. Methods of measuring power in AC circuits **Topic 9:** Non-sinusoidal current circuits.The concept of non-sinusoidal current. Fourier series. Effective and average values and power of non-sinusoidal quantities. Calculation of electrical circuits connected to a non-sinusoidal power source. Topic 10: **Transient processes.Concept of transient processes. Switching laws. Classical calculation of transient processes in simple electrical circuits. Aperiodic, limit aperiodic and oscillatory discharge of a capacitor.** **Topic 11:** Calculation of transient processes using the operator method. Calculation of transient processes using the operator method. Concepts of representation and original. Laplace transform. Operator form of Ohm's and Kirchhoff's laws. Operator scheme. Propagation theorem. Duhamel integral. **Topic 12:** Quadrupoles.Passive quadrupoles and their equations and constants. Equivalent circuits. Connections of quadrupoles. Graphs of quadrupoles and their matrices. Transfer functions of quadrupoles. **Topic 13**: Filters.Basic concepts and classification of frequency-

division filters. Low-pass filters. High-pass filters, band-pass filters. Methods of calculating filters. Rules for calculating and plotting the transfer function of a filter.

Topic 14: Electrical circuits with discrete parameters.

Basic concepts of electrical circuits with discrete parameters. Equations of a homogeneous line. Operation of a line in a sinusoidal mode, traveling waves. Interference waves.

Topic 15: Theory of Nonlinear Electrical Circuits.

Elements of nonlinear resistive electrical circuits, their parameters and characteristics. Properties, characteristics and parameters of a ferromagnetic core coil.

Topic 16: Calculation of transient processes in nonlinear electrical circuits. Methods for calculating transient processes and elements of the theory of oscillations in linear and curved circuits.

Topic 17: Electromagnetic field theory.

The integral form of the electromagnetic field equation and the magnitudes of electric and magnetic fields. Some concepts of vector analysis. The differential form of the electromagnetic field equation. Electrostatic field. Electric potential gradient. Poisson and Laplace equations.

Topic 18: Theory of a uniform electromagnetic field.

Dielectric cylinder and condition in a uniform external field. Method of representation. Expression of mechanical force in the form of the volumetric density of the electric field energy and the derivative of the electric field energy with respect to the coordinate in which it changes. Energy of the field of a system of charged bodies.

Topic 19: Calculation of the magnetic field of a constant current. The magnetic field of a constant current. Scalar and vector potential of a magnetic field. Electromagnetic field. Maxwell's equations I and II. Electromagnetic field energy. Umov-Poyting theorem

II. Instructions and recommendations for organizing laboratory exercises.

In laboratory classes, students develop practical skills and competencies in conducting experiments on various connection schemes, calculating and drawing tables and graphs in Theoretical Electrical Engineering. The recommended topics are selected based on opportunities and conditions.

Recommended topics for laboratory work:

1. Series connection of energy consumers in an alternating current circuit. (R, L; R, C; L, C).
2. Parallel connection of energy consumers in an alternating current circuit.
3. Mixed connection of energy consumers in an alternating current circuit.
4. Study of the phenomenon of mutual inductance in alternating current circuits.
5. The phenomenon of resonance in a circuit with elements connected in series.
6. The phenomenon of resonance in an electrical circuit with elements connected in parallel.
7. Study of three-phase electrical circuits connected in a star and star method.
8. Study of three-phase electrical circuits connected in a consumer triangle method.
9. Checking non-sinusoidal quantities in electrical circuits.
10. Checking the transition process of discharging a capacitor into active resistance and inductance.
11. Experimental determination of the parameters of passive quadrupole.
12. Investigation of high and low frequency filters.

13 Investigation of intermediate and blocking filters (isolators).
14. Investigation of distributed parameter electrical networks.
15. Ferroresonance of voltages.
16. Ferroresonance of currents.
17. Investigation of a ferromagnetic power amplifier.
18. Investigation of a ferromagnetic frequency doubler.
19. Investigation of the refraction of a current occurring at the boundary of media with different relative permittivity.

III. 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:

Topic1.Reconstruction of DC electric circuits. In parallel or series connection, resistors, coils and capacitors are arranged in a sequential manner

Topic 2. Ohm's and Kirchhoff's laws.

Topic 3. Reconstruction of sinusoidal current and linear electric circuits.

Topic 4. Complex method. Analysis of simple stationary electric circuits with resistive, capacitive and inductive circuits using the complex method

Topic 5. Reconstruction of interconnected electric circuits.

Topic 6. Construction of alternating current circuits and vector diagrams with active inductive and capacitive parallel connections.

Topic 7. Resonance of voltages and currents.

Topic 8. Connecting three-phase electrical circuits connected in the form of a "triangle and star".

Topic 9. Non-sinusoidal current and powerful electrical circuits.

Topic 10. Evaluation of transient processes in electrical circuits with lumped parameters by classical and operator methods.

Topic 11. Evaluation of quadrupoles.

Topic 12. Filters. Determination of the support and graph for a simple electrical filter

Topic 13. Reconstruction of electrical circuits with scattered parameters.

Topic 14. Nonlinear electrical circuits with constant current.

Topic 15. Nonlinear magnetic circuits with constant current.

Topic16. Approximation of nonlinear characteristics.

Topic17. Equivalent sinusoidal method.

Topic18. Periodic processes in nonlinear electric and magnetic circuits.

Topic19. Assignment to calculate nonlinear alternating current electric circuits.

Topic20. Calculation of periodic processes by effective values of nonlinear circuits.

Topic21. Calculation of electric circuits with controlled nonlinear elements.

Topic22. Calculation of transient processes in nonlinear circuits.

Topic23. Electrostatic field.

	Topic24. Image method. Topic25. Calculation of electric capacitance. Topic26. Calculation of the electric field of a constant current. Topic27. Calculating the magnetic field of a constant current **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. Calculation of direct current electrical circuits. 2. Calculation of alternating current electrical circuits by symbolic method. 3. Calculation of three-phase electrical circuits. 4. Calculation of quadrupoles by matrix method. 5. Calculation of transient processes in linear electrical circuits by classical method. 6. Calculation of transient processes in linear electrical circuits by operator method. 7. Propagation theorem. Duhamel integral. 8. Calculation of a three-phase alternating current circuit. 9. Calculation of a direct current magnetic circuit. 10. Calculation of a nonlinear alternating current electrical circuit.
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, laboratory classes)	10 points	
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. Charles K. Alexander Matthew N.O. Sadiku ―Fundamentals of Electric Circuits‖ NEW YORK, 2014.-458 p

2. John Bird. ―Electrical and Electronic Principles and Technology‖ LONDON AND NEW YORK, 2014.-455 p

3. Karimov A.C. Nazariy elektrotexnika. Darslik. -T: O'qituvchi, 2003. - 422 b.

4. Alimxodjayev K.T, Abdullayev V. A. Abidov K.G. Ibodullayev M.I. Elektrotexnikaning nazariy asoslari. Darslik. ―Fan va texnologiyalar‖ nashiryoti, Toshkent. 2015, -320 b.

5. Karimov A.S. Ibadullayev M.I. Abdullayev B. Elektrotexnikaning nazariy asoslari. 1-qism. Darslik. ―Fan va texnologiyalar‖ nashiryoti, Toshkent. 2017, -324 b.

6. Alimxodjayev K.T., Abdullayev B. Abidov K.G. Nazariy

elektrotexnika. 2-qism. Darslik. ―Fan va texnologiyalar‖ nashiryoti, Toshkent. 2018, -288 b.

7. Amirov S.F, Yoqubov M.S, Jabborov N.G. Elektrotexnikaning nazariy asoslari.I- III qismlar-Toshkent; 2007.- 426 b.

8. Amirov S.F, Yaqubov M.S, Jabborov N.G, Sattorov X.A, Balgayev N.E. Elektrotexnikaning nazariy asoslaridan masalalar toplami.-T: Adabiyot uchqunlari, 2015. -420 b.

9. Demirchan K.C, Neyman L.R, Korovkin H.B, hechurin V.L. Teoreticheskie osnovы elektrotexniki. - SPb. Piter, 2003.-462 s.

10.Abidov Q.G,Jorayev R,Ernst I.V, Raxmatullayev A.I. «Elektrotexnikaning nazariy asoslari» fanining «Nochiziqli zanjirlar» bo'limi bo'yicha laboratoriya ishlarini bajarish yuzasidan uslubiy ko'rsatma. TDTU, 2014.- 44 b.

11. Abidov Q.G‘, Begmatov Sh.E. «Elektrotexnikaning nazariy asoslari» fanidan virtual laboratoriya ishlarini bajarish bo'yicha uslubiy ko'rsatmalar. TDTU, 2013.- 72 b.

12. Abidov Q.G‘, Raxmatullayev A.L, Jo'rayev R, Ernst I.V, Qadirova. D.R. «Elektrotexnikaning nazariy asoslari» fanining «uch fazali zanjirlar» bo'limi boyicha hisob-grafik ishlarini bajarish yuzasidan uslubiy ko'rsatma. TDTU, 2013.-32 b.

13. Abidov Q.G‘, Qadirova. D.R. Chiziqli elektr zanjirlarida o'tkinchi jarayonlar » bo yicha hisob - grafik ishini bajarish yuzasidan uslubiy ko'rsatma. TDTU, 2010.- 36 b.

Additional literature:

14. Mirziyoyev Sh.M. Yangi O'zbekistonda erkin va farovon yashaylik. - T: "TASVIR nashriyoti", - 2021. - 50 b.

15. Mirziyoyev Sh.M. Milliy taraqqiyot yo‘limizni qat’iyat bilan davom ettiramiz va uni yangi bosqichga ko‘taramiz.-T: “O‘zbekiston”, 2017-592 b.

16. Mirziyoyev Sh.M. Biz buyuk kelajagimizni mard va olijanob xalqimiz bilan birga quramiz. – T: O‘zbekiston Milliy yangi va eng yangi tarix instituti, 2017. – 488 b.

17. O‘zbekiston Respublikasini yanada rivojlantirish bo‘yicha Harakatlar strategiyasi to‘g‘risida. T: 2017 yil 7 fevraldagi PF-4947-son qarori.

18. Rashidov Y.R, Abidov IQF, Kolesnikov I.K. «Elektrotexnikaning nazariy asoslari» fanidan 1 -oral iq, 2-oral i q va yakuniy nazorat savollari to‘plami. TDTU, 2002.-102 b.

19. Ibadullayev M. Nazariy elektrotexnika asoslari. Masala va mashqlar to‘plami.I- qism. T: O‘zbekiston, 2015.- 328 b.

20. Korovkin H.B, Selina E.E, Chechurin V.L. Теоретические основы электротехники. Сборник задач. - СПБ.ПИТЕР, 2004. -510с.

21. Abidov Q.G, Isamuxamedov S.D, Isamuxamedov U.S. «Elektrotexnikaning nazariy asoslari» fanining «O'zgarmas tok zanjirlari» bo'limi boyicha hisob- grafik ishlarini bajarish namunalari ko'rsatilgan. TDTU, 2010.- 40 b.

22. Abidov Q.G, Isamuxamedov S.D, Isamuxamedov U.S. Elektrotexnikaning nazariy asoslari» fanining «O'zgarmas tok zanjirlari» bo'limi bo'yicha hisob- grafik ishlari, Elektrotexnikaning nazariy asoslari fanining «O'zgaruvchan tok zanjirlari» bo'limi bo'yicha hisob-grafik ishlarini bajarish yuzasidan uslubiy ko'rsatma. TDTU, 2010.-31 b.

23. Abidov Q.G, Ernst I.V. «Elektrotexnikaning nazariy asoslari» fanining «Nochiziqli magnit zanjirlarini hisoblash» bo'limi bo'yicha hisob-grafik ishi bajarish yuzasidan uslubiy ko'rsatma. TDTU, 2010.- 32 b.

24. Abidov Q.G, Rashidov Y.R. Isamuxamedov S.D. Elektrotexnikani nazariy asoslari fanidan laboratoriya ishlari bajarish uchun uslubiy ko‘rsatma 1-qism. TDTU, 2007.-38 b.

25. Abidov Q.G‘, Rashidov Y.R, Isamuxamedov S.D. Elektrotexnikani

	nazariy asoslari fanidan laboratoriya ishlari bajarish uchun uslubiy ko‘rsatma 2- qism. TDTU, 2007. 46 b. **Internet resources:** 18. www.gov.uz - Government portal of the Republic of Uzbekistan. www.lex.uz - National database of legislative documents of the Republic of Uzbekistan. 19.www.prezident.uz - Press service of the President of the Republic of Uzbekistan. www.scopus.com - international scientific database. 20. www.ziyonet.uz – national educational materials search site. 21. www.gov.uz – Government portal of the Republic of Uzbekistan. 22. www.google.com – international educational materials search site. 23. www.energystrategy.ru – “Energy Policy and Strategy” information portal 24. www.twirpx.com – international educational materials search site.