

Identification	Subject	EEN211- Circuit Theory 6 ECTS credits
	Department	Physics and electronics
	Program (Undergraduate, Graduate)	Bachelor
	Term	Fall 2026
	Instructor	Shahmardan Amirov, Doctor of Physical Sciences, Associate prof.
	Email:	Phys_med@mail.ru
	Classroom/hours	Monday, 17:00-20:10
	Consultations	Thursday 16:00-17:00
Prerequisites	None	
Language	English	
Compulsory/Elective	Compulsory	
Textbooks and course materials	Textbooks: [1]. Charles K. Alexander, Matthew N.O. Sadiku Fundamentals of Electric Circuits 5-th edition, the MC Graw Hill Companies, -2013, p. 903 2. Sh. Amirov, Lecture materials	
Course description	This course offers a conceptually grounded introduction to the fundamental principles electrical circuits. It explores the key concepts of the course of “Circuit Theory” taught by the students of electronic engineering discipline provides following knowledge’s: Introduction. Electric Charge and Electric Current. Voltage. Electric Power and Energy Inductance. Voltage and Current Sources. Basic laws. Ohm’s Law. Short and open circuits. Resistance and conductance. Nodes, Branches and Loops. Fundamental theorem of network topology. KCL and KVL. Series resistors and voltage division. Parallel resistors and current division. Wye-Delta transformations. Capacitors. Series and parallel capacitors. Inductors. Series and parallel inductors. Integrator. Differentiator. First order circuits. The source-free RC circuit. The source-free RL circuit. Step response of an RC circuit AC Circuit Concepts. Sinusoidal voltage and Current in Passive elements. Inductive and Capacitive Reactance’s and Susceptance’s, Impedance and Admittance. Impedance combinations. Ohm’s and Kirchoff’s Laws for AC Circuits. Phasor relationships for Circuit Elements	
Course objectives	The main objective of this course is to provide students with a strong foundation in the fundamental principles and laws of classical mechanics, molecular physics, and thermodynamics. The course aims to: • Develop a high level of understanding of the fundamental principles of DC and AC current Systems. Develop basic laboratory skills demonstrating the application of physical principles. • Work cooperatively to facilitate a collegial atmosphere conducive to learning for all students in the class. • Prepare for and attend each class by reading the assigned sections before class, completing homework, and participating in class discussions and team activities. • Strengthen analytical thinking and problem-solving skills through the mathematical modeling of mechanical and thermodynamic processes.	

	Provide students with the essential theoretical background necessary for further study of circuit theory, particularly in the areas of 1-st and 2-nd order electrical circuits, operational amplifiers, frequency response, phasors e.t.c.		
Learning Outcomes	By the end of the course, students will be able to: Apply concepts of nodes, branches, loops, technical characteristics and classification of radio-receiving equipment, detecting of amplitude modulated signal, detecting of frequency modulated signal • Apply methods of nodal analysis, mesh analysis methods to calculate electrical circuits • Use linearity and superposition principles to calculate circuits • Use circuit theorems source transformation method • Apply Thevenin and Norton theorems to simplify the complex circuits • Explain and analyze data from physics experiments in capacitors, series and parallel capacitors, inductors, series and parallel inductors. • Explain operational principle of OP AMP integrator, differentiator. • Calculate first order circuits. The source-free RC circuit. The source-free RL circuit. Step response of an RC circuit. • Demonstrate an integrated understanding of the fundamental concepts covered in mechanics, molecular physics, and thermodynamics through quizzes, midterm assessment, and final examination.		
Teaching methods	Case analysis		x
	Group discussion		x
	Lecture		x
	Simulation		x
Evaluation Criteria	Methods	Date/deadlines	Percentage (%)
	Midterm Exam	TBA	30
	Quizzes	Four times during semester	10
	Practical Assignments	-	10
	Activity	During the term	5
	Attendance	At each lesson	5
	Final Exam	TBA	40
	Total		100
Class Policy	Preparation for class The pedagogical structure of this course necessitates diligent individual study and external preparation. Course sessions are designed to emphasize the primary theoretical frameworks introduced in the text. Pre-class engagement with assigned chapters is essential to facilitate a comprehensive understanding of the material. Subsequent to each session, students should synthesize their notes and resolve pertinent problems, case studies, and sample examination questions located at the conclusion of each chapter. Withdrawal (pass/fail) This course strictly adheres to the grading ordinances of the School of Science and Engineering. Consequently, students are required to achieve a minimum threshold of 60% to secure a passing grade. In the event of an unsatisfactory		

result, the student will be mandated to repeat the course in the following academic term or year. Cheating/plagiarism Any instance of academic dishonesty or plagiarism during Quizzes, Midterms, or Final Examinations will result in the immediate nullification of the assessment. In such cases, the student will automatically be assigned a score of zero (0) without further consideration. Generative AI Policy The use of Generative Artificial Intelligence (GAI) tools is partially permitted in this course. Students may use GAI tools for learning purposes, such as obtaining explanations of course concepts, organizing information, generating practice questions, and supporting their understanding of the course material. GAI tools may not be used to complete or generate answers for quizzes, midterm examinations, final examinations, or other assessed work unless explicitly authorized by the instructor. Students are responsible for the accuracy of any information obtained through GAI tools and must ensure that their submitted work reflects their own understanding, analysis, and intellectual contribution. Any use of GAI in accordance with the permitted purposes should be appropriately acknowledged by the student. Professional behavior guidelines Students are expected to conduct themselves in a manner that fosters a constructive academic and professional environment during instructional hours. Unauthorized discourse and unethical behavior are strictly prohibited. Attendance Students who maintain full attendance for the duration of the course will be awarded 5 marks. Conversely, for every three absences recorded, the student will incur a deduction of 1 mark. Quizzes Four quizzes will be administered throughout the semester, with formal announcements made in class two weeks prior to the assessment date. The content of each quiz is based on assigned homework problems, which are curated from the questions and problems at the end of each chapter. Activity Students who demonstrate active engagement during the review of previous lessons and proficiently solve problems during seminar sessions will be awarded one activity mark.			
Tentative Schedule			
Week	Date/Day (tentative)	Topics	Textbook/ Assignments
1	21.09.2026-	Systems of units. Charge and current. Voltage. Power and Energy. Passive sign convention. Circuit elements. Ohm's law. Open and Short circuits. Conductance and Power. Distribution of potential due to resistance in the circuit. Problem solving	[1] p. 4-28
2	28.09.2026-	Nodes, branches and loops. Network topology theorem. Kirchhoff's current law (KCL). Kirchhoff's voltage law (KVL) Problem solving	[1] p.30-80

3	05.10.2026	Series resistors and voltage division. Parallel resistors and current division. Delta to wye conversion. Wye to delta conversion Problem solving Quiz-1, Lecture 1, Lecture 2	[1] p.43-52
4	12.10.2026	Nodal analysis without voltage source. Nodal analysis with voltage source. Super node. Problem solving	[1] p.82-127
5	19.10.2026	Mesh analysis without current source. Mesh analysis with current source. Super mesh. Problem solving	[1] p.90-100
6	26.10.26	Linearity. Superposition principle. Problem solving Quiz-2; Lectures 3,4,	[1] p.128-135
7	2.11.2026	Source transformation. Thevenin theorem Problem solving	[1] p.137-145
	TBC	Midterm exam	
8	9.11.2026	Norton's theorem. Maximum power transfer. Problem solving	
9	16.11.2026	Operational amplifiers. A structure of Op Amp. Ideal Op Amp. Inverting Op Amp. Noninverting Op Amp. Summing Op.Amp. Digital to analog converter (DAC). Difference Op Amp. Instrumentation Op.Amp. Cascaded Op.Amp. Problem solving	[1] p.176-191
10	23.11.26	Capacitors and Inductors. Series combination of capacitors. Parallel combination of capacitors. Inductors. Series combination of inductors. Parallel combination of inductors. Integrator. Differentiator. Problem solving Quiz-3 Lectures 7,8,9	[1] p.216-230
11	30.11.26	Ac Circuits. Sinusoids and Phasors. Introduction. Sinusoids. Phasor relationship. Impedance and admittance. Kirchhoff's laws in the frequency domain. Period, frequency, angular frequency, peak value, epoch angle. AC Average value, root-mean square value. Peak factor. Form factor.	[1] p.370-390
12	07.12.26	Frequency Response Passive Filters. Lowpass Filter. Bandpass Filter. Bandstop Filter. Active Filters: First-order Lowpass Filter. First-order Highpass Filter. BandPass Filter. Bandreject (or Notch) Filter	[1] p.614-648
13	14.12.26	First-order circuit: Source free RC and RL circuits. OP AMP circuits. Second-order circuit Source free series and parallel RLC circuits. OP AMP circuits. Quiz-4 Lectures 10,11, and 12	[1] p.254-283
14	21.12.26	Representation of sinusoidal quantities by vectors and complex numbers. Addition of sinusoidal time functions. Series connection of resistance, inductance and capacitor. Parallel connection of resistance, inductance and capacitor.	[1] p.556-573

15	28.12.26	Resonance circuits. Series (voltage) resonance. Parallel (current) resonance. Magnetically Coupled circuits. Transformer. Impedance transformations Two-port networks. Impedance parameters. Admittance parameters. Hybrid parameters. Transmission parameters. Relationships between parameters.	[1] p.854-873
		Final exam	

