S Y L L A B U S

General information	**Title and code of subject, number of credits**	EENG211 Circuits Theory 6 ECTS	
	Department	Physics and electronics	
	Program	Bachelor	
	Academic semester	2024 fall	
	Lecturer	Doctor of philosophy (PhD) in Physics & Mathematics Shahmerdan Sh. Amirov	
	E-mail:	phys_med@mail.ru	
	Phone number:		
	Lecture room/Schedule	11 Mehseti Street, AZ1096 Baku, Azerbaijan (Neftchilar campus), room Lectures: Seminars:	
	Consultations		
Course language	English		
Type of the subject	Major		
Textbooks and additional materials	***Textbooks*:** **1. Charles K. Alexander, Mattew N.O.Sadiku Fundamentals of circuit theory** **2. R Akhmedov Circuits Theory** **3. Sh.Sh. Amirov Lecure materials** **4. R.M. Hajiyev Theoretical bases of electrical circuits 2011** **Auxiliary Web sources:** https://www.youtube.com/watch?v=BgvRi0Jl43g https://www.youtube.com/watch?v=VJfIbBDR3e8&list=PL5351D9CFF725FA6A https://www.youtube.com/watch?v=dEdR4iOdLh0&list=PL5DUVGfj6BJa4THJwSN8wJljvkHvInrMq https://www.youtube.com/watch?v=4ZoKGFLg0HQ https://www.youtube.com/watch?v=Gv0VMx25_Dk https://www.youtube.com/watch?v=9SUHgtREWQc https://www.youtube.com/watch ?v=Ok9ILIYzmaY https://www.youtube.com/watch?v=v38-I58H2Uc&list=PLc1hOdhp9OEF-PbWusarZmubWggC_zp3K		
Teaching methods	**Lecture**		15
	Group discussions at seminars		15
Assessment	**Components**	**Date/ Deadline**	**Percent (%)**
	Tests	During the semester	10
	Active participation	At each lesson	10
	Individual research papers and presentations	At the end of the semester	15
	Attendance		5
	Midterm exam		25
	Final exam		35
	Final		**100**
Course description	This course introduces imaging methods in medicine and biology. Various medical imaging modalities (x-rays, CT, MRI, ultrasound, PET, SPECT, optical imaging, etc.) and their applications in medicine and biology. Extends basic concepts of signal processing to the two and three dimensions relevant to imaging physics, image reconstruction, image processing, and visualization. The basic physical and engineering principles behind major medical imaging techniques will be described, and their relative advantages and disadvantages will be explored. The capabilities of the imaging techniques will be explained in terms of performance criteria such as spatial and temporal resolution, contrast, and signal-to-noise-ratio. The effectiveness of the methods will be illustrated in terms of their clinical applications. An historical perspective of the development of each technique will be presented, as well as the latest innovations. Finally, potentially new and emerging medical imaging technqiues will be considered.		
Course objectives	The main objective of this course is to enable students to develop a basic familiarity with all the major medical imaging techniques employed in modern hospitals, including x-ray imaging, computer tomography, magnetic resonance imaging, ultrasound, nuclear isotope imaging, and		

	electroencephalography. Each technique will be introduced in the context of the underlying clinical requirements. Students need to learn what physical principles are involved, and what properties of tissues the corresponding medical images show. The module will aim to develop an understanding of the historical evolution of these imaging methods, as well as indicate how medical imaging is likely to develop over the next few years.
Learning outcomes	What students should know by the end of the course: Ionizing Radiation, Radiation dosimetry, risk and protection. Radiation Biology. Radiography, Film-screen and digital, Mammography & Fluoroscopy. Optical imaging. Ultrasound Imaging. Ultrasound Image Analysis. Computed Tomography. Magnetic Resonance Imaging (MRI). Nuclear Medicine Imaging. Imaging applications in Therapy.
Rules (Educational policy and behavior)	Lesson organization General information on the subject will be provided for the students during lectures. Student's knowledge on the previous topics will be evaluated and new topic will be explained by mins of visual aids during seminars. Student's knowledge level will be tested oraly and in written forms before midterm and final exams. Submission of the individual works by the end of course is obligatory. Attendance Participation of students at all classis is important. Students should inform dean's office about missing lessons for particular reasons (illness, family issues and etc.). Students, missing more than 25% of lessons, are not allowed to take the exam. Lates Those students who are late for lessons for more than 15 minutes are not allowed to participate at the lesson. Despite this, the student is allowed to take part in the second part of the lesson. Tests Those students who have informed the teacher and the dean's office about missing the test in advance for particular reasons, are allowed to take the test next week. Exams All the issues related to the participation and admission to the exam are regulated by the faculty dean. Topics of midterm and final exams are provided for the students before the exams. The questions of midterm exam are not repeated in the final exam. Violation of the rules of the exams Disrupting the test and taking copy during midterm and final exams is forbidden. Test papers of the student who do not follow these rules are canceled and the students are expelled from the test by getting 0 (zero). The rule for completing the course In accordance with the University rules the overall success rate to complete the course should be 60% or above. The students who failed the exam would be to take this subject next semester or next year. Rules of conduct for Students Disruption of the lesson and not following ethical norms during the lesson, as well as conduction of the discussions by the students without permission and using mobile phones is forbidden.

This program reflects the comprehensive information about the subject and information about any changes will be provided in advance.

Week	Dates (planned)	Subject topics	Textbook/ Assignments
1	*11.09.24*	***Lecture №1.*** **Introduction. Basic concepts.** 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.	[1] p. 4-28 [3]
		Seminar №1: *Solving problems* 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.	[1] p.2-2
2	*18.09.24*	***Lecture №2.*** **Basic laws in circuit theory.** Nodes, branches and loops. Network topology theorem. Kirchhoff's current law (KCL). Kirchhoff's voltage law (KVL). Series resistors and voltage division. Parallel resistors and current division. Delta to wye conversion. Wye to delta conversion.	[1] p.30-80 [3]
		Seminar №2: *Solving problems.* Nodes , branches and loops. Network topology theorem. Kirchhoff's current law (KCL). Kirchhoff's voltage law (KVL). Series	[1] p.

		resistors and voltage division. Parallel resistors and current division. Delta to wye conversion. Wye to delta conversion	
3	***25.09.24***	***Lecture №3***. **Methods of analysis.** Nodal analysis without voltage source. Nodal analysis with voltage source. Supernode. Mesh analysis without current source. Mesh analysis with current source. Supermesh.	[1] p.82-127 [3]
		Seminar №3: *Solving problems.* Nodal analysis without voltage source. Nodal analysis with voltage source. Supernode. Mesh analysis without current source. Mesh analysis with current source. Supermesh.	[1] p.
4	***02.10.24***	***Lecture №4.***. **Circuit theorems.** Linearity. Superposition principle. Source transformation. Thevenin's theorem. Norton's theorem. Maximum power transfer.	[1] p. 128-174 [3]
		Seminar №4: *Solving problems* . Linearity. Superposition principle. Source transformation. Thevenin's theorem. Norton's theorem. Maximum power transfer.	[3] p.
5	***09.10.24***	***Lecture №5***. **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.	[1] p.175-215 [3]
		Seminar №5: *Solving Problems* 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.	[1] p.
6	***16.10.24***	***Lecture №6.*** **Capacitors and Inductors.** Series combination of capacitors. Parallel combination of capacitors. Inductors. Series combination of inductors. Parallel combination of inductors. Integrator. Differentiator.	[1] p.216-252 [3]
		Seminar №6: : *Solving Problems* Series combination of capacitors. Parallel combination of capacitors. Inductors. Series combination of inductors. Parallel combination of inductors. Integrator. Differentiator.	[1] p.
7	***23.10.24***	***Lecture №7.*** **Ac Circuits. Sinusoids and Phasors.** Introduction. Sinusoids. Phasors. Phasor relationship for Circuit Elements. Impedance and admittance. Kirchhoff's laws in the frequency domain.	[1] p.370-411 [3]
		Seminar №7: : *Solving Problems* . Sinusoids. Phasors. Phasor relationship for Circuit Elements. Impedance and admittance. Kirchhoff's laws in the frequency domain.	[1] p.
8	***30.10.24***	***Lecture №8***. **Frequency Response .** Passive Filters. Lowpass Filter. Bandpass Filter. Bandstop Filter.	[1] p.613-647 [3]
		Seminar №8: *Solving Problems* Passive Filters. Lowpass Filter. Bandpass Filter. Bandstop Filter.	[1] p.
9	***06.11.24***	***Mid term exam***	
10	***13.11.24***	***Lecture №9.*** **Frequency Response** Active Filters: First-order Lowpass Filter. First-order Highpass Filter. BandPass Filter. Bandreject (or Notch) Filter	[1] p.2-2 [3]
		Seminar №9: *Solving Problems* Active Filters: First-order Lowpass Filter. First-order Highpass Filter. BandPass Filter. Bandreject (or Notch) Filter	[1] p.

11	***20.11.24***	***Lecture №10.*** **Sinusoidal alternating current circuit**. Basic definitions. Period, frequency, angular frequency, peak value, epoch angle. **AC** Average value, root-mean square value. Peak factor. Form factor.	[2] p. [3]
		Seminar №10: *Solving Problems* Basic definitions. Period, frequency, angular frequency, peak value, epoch angle. **AC** Average value, root-mean square value. Peak factor. Form factor.	[2] p.
12	***27.11.24***	***Lecture №11.*** **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.	[2] p.
		Seminar №11: *Solving Problems* Addition of sinusoidal time functions. Series connection of resistance, inductance and capacitor. Parallel connection of resistance, inductance and capacitor.	
13	***04.12.24***	***Lecture №12.*** **Resonance circuits**. Series (voltage) resonance. Parallel (current) resonance.	[2] p
		Seminar №12: *Solving Problems* Series (voltage) resonance. Parallel (current) resonance.	[2] p.
14	***11.12.24***	***Lecture №13.*** **Magnetically Coupled circuits**. Transformer. Impedance transformations.	[2] p.
		Seminar №13: *Solving Problems* Transformer. Impedance transformations.	[2] p.
15	***18.12.24***	***Lecture №14.*** **Power Analysis.** Instantaneous and average power**.**.Power in circuits. Power factor. Active reactive power. Maximum power transformation.	[2] p.
		Seminar №14: *Solving Problems* Instantaneous and average power**.**.Power in circuits. Power factor. Active reactive power. Maximum power transformation.	[2] p.
16	***25.12.24***	Lecture ***№15.*** **Complex transfer function**. Analyzing RC Circuits. Analyzing RLC circuit	[2] p.
		Seminar №15: *Solving Problems* RC and RLC circuits.	[2] p.
		Final Exam