General information	**Title and code of subject, number of credits**	ETR476 Radio Transmitting and Antenna Devices 6 ECTS	
	Department	Physics and Electronics	
	Program	Bachelor	
	Academic semester	2022, spring	
	Lecturer	**PhD, Associate Prof. Elchin Hasanov**	
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	Lecture room/Schedule	11 Mehseti Street, AZ1096 Baku, Azerbaijan (Neftchilar campus), room Office hours: Wednesday 14:00 – 15:00	
Prerequisites	ETR 234 – Analog and digital electronics		
Course language	English		
Type of the subject	Major		
Textbooks and additional materials	***Textbooks*:** **1. Constantine A. Balanis Antenna Theory, Analysis and Design.** **2. Chuck Fung. Antenna basic theory, 2011** **3. Richard C.Johnson. Antenna Engineering Handbook, 1993**		
Teaching methods	**Lecture**		x
	Group discussions at seminars		x
Assessment	**Components**	**Date/ Deadline**	**Percent (%)**
	Quizzes	During the semester	5
	Active participation	At each lesson	5
	Individual research papers and presentations	At the end of the semester	15
	Attendance	At each lesson	5
	Midterm exam		30
	Final exam		40
	Final		**100**
Course description	This course introduces types of Antennas. Radiation Mechanism. Single wire. Wire configurations for radiation. Current distribution on a thin wire antenna. Beam efficiency. Bandwidth. Polarization. Input impedance. Antenna radiation efficiency. Frequency independent antennas , aperture antennas, microstrip antennas, horn antennas, reflector antennas. The basic physical and engineering principles of antennas 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 antenna technique will be presented, as well as the latest innovations.		
Course objectives	The main objective of this course is to enable students to develop a basic familiarity with the fundamental principles of antenna theory and to apply them to the analysis, design, and measurements of antennas . Because there are so many methods of analysis and design and a plethora of antenna structures, applications are made to some of the most basic and practical configurations, such as linear dipoles; loops, arrays ; broadband, and frequency-independent antennas; aperture antennas; horn antennas; microstrip antennas and reflector antennas.		
Learning outcomes	**What students should know by the end of the course:** - Types of Antennas. Radiation Mechanism - Linear wire Antennas. Infinitesimal Dipole. Small Dipole. - Linear, planar and circular arrays. Two-element array. - Integral equation method.Finite diameter wires. Moment method solution.		

	- Aperture antennas. Field equivalence principle: Huygens' principle - Broadband dipoles and matching techniques. Biconical antennas
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 means of visual aids during seminars. Student's knowledge level will be tested orally 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	***19.02.22***	Introduction. Types of Antennas. Radiation Mechanism. Single wire. Wire configurations for radiation. Two wires. Dipole. Current distribution on a thin wire antenna.	[1] p. 7-27 [2]
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	[1] p.2-2
2	***26.02.22***	Fundamental parameters of antennas.Radiation Pattern. Radiation Power Density.Radiation intensity . Beamwidth. Directivity.Numerical techniques. Antenna Efficiency.Gain.	[1] p.27-69 [3]
		Examination knowledges of students individually on the material of respective lecture. Analysi s the lecture material in details. Solving problems.	[1] p.
3	***05.03.22***	Beam efficiency. Bandwidth. Polarization. Input impedance. Antenna radiation efficiency. Antenna vector effective length and equivalent areas. Maximu directivity and maximum effective area.Friis transmission Equation and Radar Range equation. Antenna temperature.	[1] p.69-95 [3]

		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	[1] p.
4	***12.03.22***	Linear wire Antennas. Infinitesimal Dipole. Small Dipole. Region separation. Finite length dipole. Half-wavelength dipole. Linear elements near or on infinite perfect conductors. Ground effects.	[1] p. 151-205 [3]
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	[3]
5	***19.03.22***	Loop antennas. Small circular loop. Circular loop of constant current. Circular loop with nonuniform current. Ground and Earth curvature efffects for circular loops. Polygonal loop antennas. Ferrite loop antennas. Mobile communication systems applications.	[1] p.231-266 [3]
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	[1] p.
6	***26.03.22***	Linear, planar and circular arrays. Two-element array. N-element linear array:Uniform amplitude and spacing. Directivity.Design procedure. Three-dimensional characteristics.	[1] p.283-320 [3]
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems. Rectangular-to-Polar Graphical solution.N-element linear array:Uniform spacing.Nonuniform amplitude .Superconductivity. Planar array.Design considerations.Circular array.	[1] p.322-365
7	***02.04.22***	Continuous sources.Schelkunoff Polynomial method. Fourier Transform method.Woodward-Lawson Method. Taylor-line-source. Triangular, cosine, and cosine-squared amplitude distributions.Line-source phase distributions.Continuous aperture sources.	[1] p.385-419 [3]
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	[1] p.
8	***09.04.22***	Integral equation method.Finite diameter wires. Moment method solution. Self impedance. Mutual impedance between linear elements.Mutual coupling in arrays.	[1] p.433-478 [2]
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	[1] p.
9	***16.04.22***	***Mid term exam***	
10	***23.04.22***	Broadband dipoles and matching techniques. Biconical antenna. Triangular sheet,bow-tie and wire simulation.Cylindrical dipole.Folded dipole.Discone and Conical Skirt Monopole.Matching techniques. Traveling wave antennas. Broadband antennas.	[1] p.497-556 [3]
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	[1] p.

11	***30.04.22***	Frequency independent antennas**.**Theory. Equiangular Spiral antennas.Log-periodic antennas.Fundamental limits of electrically small antennas. Fractal antennas.	[1] p.611-641 [3]
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	[2] p.
12	***07.05.22***	**Aperture antennas.** Field equivalence principle: Huygens' principle. Radiation equation. Directivity. Recangular apertures. Circular apertures. Design considerations. Babinet's principle. Fourier transforms in aperture antenna theory. Ground plane.	[1] p.653-701
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	
13	***14.05.22***	**Horn antennas.** E-plane sectoral horn. H-plane sectoral horn. Pyramidal horn. Conical horn. Corrygated horn. Aperture-atched horns. Multimode horns. Dielectric loaded horns. Phase center.	[1] p.739-799
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	[2] p.
14	***21.05.22***	**Microstrip antennas.** Rectangular patch. Circular patch. Quality factor, bandwith, efficiency. Input impedance. Coupling. Circular polarization. Arrays and feed networks.	[1] p.811-865
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	[2] p.
15	***28.05.22***	**Reflector antennas.** Plane reflector. Corner reflector. Parabolic reflector. Spherical reflector. Smart antennas. Sartr-antenna analogy. Cellular radio systems evolution. Signal propagation. Antenna beamforming.	[1] p.883-958
		Examination knowledges of students individually on the material of respective lecture. Analysis the lecture material in details. Solving problems.	[1] p.
		Final Exam