General information	**Title and code of subject, number of credits**	ETR476 Fundamental radio engineering 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: Saturday 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 outline	Complex radio and related systems like aircraft, satellites, ships, ground vehicles and launch vehicles consist of thousands of different parts that all work together to achieve one or more value-added functions. Examples of such functions are transporting people and goods from one place to another or gathering and disseminating information from remote locations. The parts can be hardware, software or "human ware". Humans are indeed an integral part of these systems as designers, operators, passengers and maintainers. This also applies to other non-aerospace systems such as complex consumer products, medical devices and so forth. We use the term "stakeholders" to identify people and organizations that have an interest in the system's success. *Radio Engineering* is a discipline whose aim it is to coordinate all design and management activities during technical projects in a way that the outcome meets requirements and that these requirements satisfy stakeholder needs. In other words systems engineering is about designing and managing the parts, their interfaces and their collective behavior in a way that produces the intended outcome.		
Course objectives	The students in this class will be able to achieve the following learning outcomes: • Describe the most important Systems Engineering standards and best practices as well as newly emerging approaches. • Structure the key steps in the systems engineering process starting with stakeholder analysis and ending with transitioning systems to operations.		

	• Analyze the important role of humans as beneficiaries, designers, operators and maintainers of aerospace and other systems. • Characterize the limitations of the way that current systems engineering is practiced in terms of dealing with complexity, lifecycle uncertainty and other factors. • Apply some of the fundamental methods and tools of systems engineering to a simple cyber-electro-mechanical system as a stepping stone to more complex and real world projects.
Learning outcomes	What students should know by the end of the course: Students must aware few very important details- - Voltage, Current, and Generic Circuit Elements - Ideal Circuit Element - Electric Circuits and Interconnection Law - Series and Parallel Circuits - Equivalent Circuits: Impedances and Source - Transfer Functions
Rules (Educational policy and behavior)	a. **Lectures**: The lectures will last 2 hours (including breaks) and will present some of the key ideas and concepts for particular steps of the systems engineering process. The lectures will be held on Fridays and will roughly follow the "V" model of systems engineering. Lecture notes will be posted on the course site the day of the lecture. During the lecture we will ask concept questions online[4] which are used to both check conceptual understanding as well as for taking attendance. b. **Assignments**: Small teams of students will do the assignments. Each team will turn in *one deliverable* per assignment with all team members that contributed clearly identified. The assignments will be scheduled such that they are more or less synchronized with the class materials. The assignment teams will have a team size of five (5) and there will be a total of five (5) assignments over the course of the semester. Student teams will be primarily formed separately for MIT and EPFL students. However, depending on the number of participants at both schools we may allow mixed teams. c. **Readings**: The readings in this class are of *two types*. First, we will assign weekly readings from the Radio Systems Engineering Handbook and potentially other standard SE texts to supplement the class materials. You can expect to read about 30–40 pages per week in this fashion. It is important to read ahead of class to get more from the lectures. Second, we will have one or two journal or conference papers per week as assigned post- reading. These post-readings will be discussed during lecture and are not mandatory but are intended to provide a fresher and more in-depth perspective compared to the RE standard texts. d. **Exams**: There will be one examination in this class. The first will be a written on-line quiz where students show their understanding of key RE concepts. This exam will be administered about two-thirds through the semester once the bulk of the RE theory has been covered. The quiz will be open-book and open-internet. There will also be a short individual oral examination (20 minutes) at the end of the semester, which will take the form of a general discussion about RE fundamentals and its potential future applications.

Week	**Dates (planned)**	**Subject topics**	**Textbook/ Assignments**
1	***19.02.22***	Introduction. Radio Engineering Overview and Stakeholder Analysis. Requirements Definition	[1] p. 7-27 [2]
		System Architecture and Concept Generation Design Definition and Multidisciplinary Optimization	[1] p.2-2
2	***26.02.22***	Radio engineering, Radio electronic systems/ Communication with moving objects	[1] p.27-69 [3]
		Design of radio-electronic facilities	[1] p.
3	***05.03.22***	Statistical radio engineering, theory of optimal reception, theory of telecommunications.	[1] p.69-95

			[3]
		Comprehensive protection of information objects Theory of telecommunications, theory of information security, programming in high-level languages, hardware and software methods of information security.	[1] p.
4	***12.03.22***	Radio physics. Calculation, modeling, and simulation of processes occurring in antenna, receiving and transmitting devices.	[1] p. 151-205 [3]
		Work on finding and eliminating complex damage in equipment, equipment, performing work on complex measurements, setting up, bringing channels, equipment and equipment to established standards, installing and repairing technical equipment.	[3]
5	***19.03.22***	Acceptance of prototypes, development of measures for the modernization of serviced equipment, equipment, preparation of proposals for the development and reconstruction of technical means, development of instructions for the operation of prototypes of new equipment	[1] p.231-266 [3]
		Antenna subsystem, transmitting subsystem, receiving subsystem and software and hardware complex.	[1] p.
6	***26.03.22***	Features of the formation of radio links at different frequencies. Scientific and engineering automated systems	[1] p.283-320 [3]
		Messages and their sending by a radio transmitter. Processes in the radio receiver. Radio communication system Digital Integrated Circuits.	[1] p.322-365
7	***02.04.22***	How the basic radio engineering processes are carried out Radio engineering systems for various purposes	[1] p.385-419 [3]
		An example of a radio system device: a television system	[1] p.
8	***09.04.22***	Why does an engineer need to know history? The Emergence of the Science of Telecommunications.	[1] p.433-478 [2]
		Experiment is the criterion of truth. Pioneers of domestic radio engineering	[1] p.
9	***16.04.22***	***Mid term exam***	
10	***23.04.22***	Materials, components, devices. Classification of electro radioelements.	[1] p.497-556 [3]
		Electrovacuum devices. Gas-discharge devices. Solving problems.	[1] p.
11	***30.04.22***	Semiconductors Linear integrated circuits Digital integrated circuits.	[1] p.611-641 [3]
		Passive electroradioelements. Solving problems.	[2] p.
12	***07.05.22***	Engineer in the research and production cycle. The main stages of the production process.	[1] p.653-701
		The idea is the concept of the product. Design - optimization of the solution. Manufacture (production) of products.	

		Solving problems.	
13	***14.05.22***	Radio engineering branch of the national economy. Automated Systems.	[1] p.739-799
		Organization and interaction of industrial enterprises Solving problems.	[2] p.
14	***21.05.22***	On the way to becoming a radio engineer	[1] p.811-865
		Being a radio engineer is not easy, but very exciting Solving problems.	[2] p.
15	***28.05.22***	Manufacture (production) of products. Intention - idea about the product	[1] p.883-958
		Design - Solution Optimization Solving problems.	[1] p.
		Final Exam