S Y L L A B U S

General information	**Title and code of subject, number of credits**	ETR 246, Telecommunication networks and systems, 6 ECTS	
	Department	Physics and Electronics	
	Program	Bachelor	
	Academic semester	Spring 2026	
	Lecturer	MSc, Yusif Shamayev	
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	Phone number:		
	Lecture room/Schedule	11 Mehseti Street, AZ1096 Baku, Azerbaijan (Neftchilar campus), room	
	Consultations	Saturday 13:00 – 14:00	
Course language	English		
Type of the subject	Major		
Textbooks and additional materials	Textbooks: 1. Telecommunication Switching Systems and Networks, PHI 2003 2. William.C.Y.Lee,—Mobile Cellular Telecommunications-Analog and Digital Systems‖, Second Edition, TataMcGraw Hill Edition, 2006. 3. The Telecommunications Handbook: Engineering Guidelines for Fixed, Mobile and Satellite Systems 1st Edition –Wiley Publication, 2021 4. Satellite Communications in the 5G Era – Shree Krishna Sharma, 2018 5. Annabel Z. Dodd – The Essential Guide to Telecommunications, 6th Edition, 2019 6. Telecommunication Systems Engineering .Wiley, 2022		
Teaching methods	**Case analysis**		x
	Group discussion		x
	Lecture		x
	Simulation		x
Evaluation Criteria	**Components**	**Date/ Deadline**	**Percent (%)**
	Activity	At each lesson	5
	Quizzes	4 times during the semester	20
	Attendance	At each lesson	5
	Midterm exam		30
	Final exam		40
	Final		**100**
Course description	This course offers an in-depth study of modern telecommunication networks and systems, focusing on both theoretical foundations and practical applications. Students will gain a thorough understanding of communication principles, signal transmission, network architectures, and protocols used in wired and wireless systems. Key topics include digital and analog transmission techniques, switching and routing methods, network		

	topologies, performance evaluation, and emerging trends in telecommunication technologies. The course combines lectures, problem-solving sessions, and case studies to develop the skills necessary for designing, analyzing, and managing efficient telecommunication networks.
Course objectives	• Introduce the fundamental principles of telecommunication networks, architectures, and system components. • Explain the structure and operation of wired and wireless communication networks. • Develop understanding of network models and protocols, including the OSI and TCP/IP reference models. • Provide theoretical knowledge of data transmission techniques, multiplexing, switching, and routing methods. • Analyze the performance of telecommunication networks in terms of bandwidth, latency, throughput, and reliability. • Introduce concepts of network planning, design, and management. • Familiarize students with modern telecommunication technologies such as IP networks, optical fiber systems, mobile communication networks, and 5G/next-generation networks. • Prepare students for advanced studies and practical work in telecommunications, networking, and communication engineering.
Learning outcomes	After successfully completing this course, students will be able to: 1. Students will demonstrate knowledge about Telecommunication Systems and networks. 2. Students will be able to analyze different switching methodologies. 3. Students will be able to differentiate between signaling methods used in Telecommunication systems and Networks 4. Students will exhibit a good knowledge on data communication networks and ISDN and be able to differentiate LAN, MAN, WAN 5. Students will demonstrate an ability to work on various Telecommunication systems and Network concepts. 6. Students will demonstrate knowledge on modern telecommunication concepts like IMS & SDN.
Rules (Educational policy and behavior)	▪ **Preparation for class** The structure of this course makes your individual study and preparation outside the class extremely important. The lecture material will focus on the major points introduced in the text. Reading the assigned chapters and having some familiarity with them before class will greatly assist your understanding of the lecture. After the lecture, you should study your notes and work on relevant problems and cases from the end of the chapter and sample exam questions. ▪ **Withdrawal (pass/fail)** This course strictly follows the grading policy of the School of Science and Engineering. Thus, a student is expected to achieve a mark of at least 60% to pass. In case of failure, he/she will be required to repeat the course thefollowing term or year.

	▪ **Cheating/plagiarism** Cheating or other plagiarism during the Quizzes, Midterm, and Final Examinations will lead to paper cancellation. In this case, the student will automatically get zero (0) without consideration. ▪ **Professional behavior guidelines** The students shall behave in a way to create a favorable academic and professional environment during class hours. Unauthorized discussions and unethical behavior are strictly prohibited. ▪ **Attendance** Students who attend the whole class will get 5 marks. For three absences student loses 1 mark. ▪ **Activity** Students who will be active during the discussion of past lessons and who will solve homework problems in a lesson will be awarded one activity mark. ▪ **Quizzes** There will be 4 quizzes during the semester. The quizzes will be announced in the classroom two weeks before. The quiz is based on homework problems. The homework problems will be selected from questions and problems at the end of each chapter. The number of homework problems will be announced after finishing each chapter. 20 percent of the average score of all the quizzes will be added to the final exam scores.

Week	**Dates (planned)**	**Subject topics**	**Textbook/ Assignments**
1		*Introduction:* Evolution of telecommunications, simple telephone communication, switching systems, Strowger switching system, crossbar switching, and basic knowledge about satellite and ground stations for GEO and LEO satellites.	[1] p. 2-16
2		*Introduction(Cont):* Major telecommunication networks. Electronic Space Division Switching . Stored program control . Centralized SPC, distributed SPC	[1] p. 4-20 [1] p.30-52 [1] p. 24-28 [1] p. 67-81
3		*Time Divison Switchings and CDM:* Time Division Switching . Time multiplexed space switching . time multiplexed time switching . combination Switching . three stage combination switching . n-stage combination switching	[2] p. 31-57 [2] p. 76-85
4		*Time Divison Switching(Cont):* Traffic Engineering: Network traffic load and parameters . grade of servicVe and blocking probability . modeling switching systems, . incoming traffic and service time characterization. blocking models and loss estimates . delay systems.	[2] p. 113-146 [2] p. 153-155

		incoming traffic and service time characterization. blocking models and loss estimates . delay systems.	
5		*Data networks and digital communication*. Data networks, Block diagram, features, working of EPABX systems . data transmission in PSTNs . modems, switching techniques for data transmission circuit switching, store and forward switching data communication architecture Digital radio modulations. Amplitude Modulation (AM), Frequency Modulation (FM), Binary Phase Shift Keying (BPSK), Quaternary Phase Shift Keying (QPSK), Gaussian Minimum Shift Keying (GMSK), OFDM (DMT – used in ADSL over twisted pair), adaptive orthogonal modulation. Asynchronous Transfer Mode (ATM), adaptable and flexible multiplexing. OSI model. IT networks, Ethernet (IEEE 802.3, 801.11, 802.16), LAN, MAN, WAN. Terms: HUB, Bridge, Router, NAC address, IP address.	[3] p. 216-240 [3] p. 124-148
		Quiz 1(Lesson 1-Lesson 4)	
6		***Public holiday***	
7		*ITU protocols and requirements*. ISO-OSI reference model, link to link layers, physical layer, data link layer, network layer, end to end layers, transport layer, session layer, presentation layer, Satellite based data networks . LAN, metropolitan area network, fiber optic networks, and data network standards.	[3] p. 173-198 [3] p. 201-208 [3] p. 201-208
8		*Telephone Networks and traffic engineering.* Telephone Networks: Subscriber loop systems, switching hierarchy and routing, transmission plan, Transmission systems, numbering plan, charging plan, Network Traffic load and parameters, Grade of service and blocking probability, Modeling Switching Systems, Incoming Traffic and Service Time ***Quiz 2 (Lesson 5- Lesson 6)***	[3] p. 271-300 [3] p. 310-314
9		***Mid term exam***	
10		*PSTN and NGN in Telecommunication* Models of telecommunications system. Telecommunication networks: the topology of telecommunications networks, hierarchies, numbering, routing, tunneling, channel and packet switching. Central and access network. Next generation network	[4] p. 384-422 [4] p. 425-557

		NGN, migration of existing telecommunications networks to NGN. Migration paths. The most existing telecommunications networks; PSTN switching, switching elements, switching exchange AXE - 10 structures. Signaling networks and network transmission customer service as logically separate subnet. N - ISDN upgrade to AXE commutations BRA, PRA. The migration of PSTN and ISDN to NGN. W - ISDN, broadband access networks as NGN. IP / MPLS core network. Physical and transmission level ATM network (ATM, adaptable and flexible multiplexing.) and Ethernet (GbEthernet, 10GbEthernett, Fast Ethernet	
11		*Integrated Services Digital Networks* Integrated Services Digital Networks: Motivation for ISDN new services, network and protocol ***Quiz 3(Lesson 7- Lesson 10)***	[4] p. 565-588 [4] p. 596-600
12		*Transport network in Telecommunication and optical and satellite systems* Synchronous and asynchronous, static and dynamic time division multiplexing. Plesiochronous digital hierarchy, primary group, secondary group, groups of higher levels. Synchronous digital hierarchy. Multiplexing PDH signals into SDH STM-1 transport module. Transmission media. Optical fibres: single mode, multimode. Optical cables. Wavelength division multiplexing (WDM): Dense wavelength division multiplexing (DWDM) and Coarse wavelength. Satellite systems	[4] p. 602-635 [4] p. 667-693 [4] p. 636-638 [4] p. 694-698
13		*Telecommunication network organization* Network management, Network services, various networking plans, types of networks, Routing plan, International numbering plan, National numbering plan, Numbering plan in Azerbaijan	[5] p. 764-788 [5] p. 801-805
14		*Overview of VOIP, IP switching and Mutimedia IP systems and the role telecommunication industry in Industry 4.0*	[5] p. 807-825
15		***Recap of all covered material*** ***Quiz 4(Lesson 11- Lesson 13)***	
		Final Exam	