S Y L L A B U S

General information	**Title and code of subject, number of credits**	ETR401 Wireless communication technology- 6 ECTS
	Department	Physics and Electronics
	Program	Bachelor
	Academic semester	2019 fall
	Lecturer	Doctor of philosophy (PhD), associate professor, Farida Tatardar
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	Lecture room/Schedule	11 Mehseti Street, AZ1096 Baku, Azerbaijan (Neftchilar campus), room
	Consultations	Friday 12:00 – 13:20
Prerequisites	ETR 237	
Course language	English	
Type of the subject	Major	
Textbooks and additional materials	***Textbooks*:** 1. Wireless communication, Stanford University Copyright c 2004 by Andrea Goldsmith 2. Wireless communication by Andrea Goldsmith, Copyright 2005 by Cambridge University Press. 3. Wireless Communication Technologies: New Multimedia Systems, Edited by Norihiko Morinaga Osaka University Ryuji Kohno Yokohama National University Seiichi Sampei Osaka University Kluwer Academic Publishers New York, Boston, Dordrecht, London, Moscow, 2016 4. Fundamentals of Wireless Communication, David Tse and Pramod Viswanath Cambridge University Press, 2005 5. Wireless Communications Dec 1, 2010 by Andreas F. Molisch 6. EDITED BY AFIF OSSEIRAN Ericsson JOSE F. MONSERRAT Universitat Politècnica de València PATRICK MARSCH, 5G Mobile and Wireless Communications Technology, Cambridge University Press 2016 **Auxiliary Web sources:** http://en.booksee.org/book/1303881 https://people.eecs.berkeley.edu/~dtse/book.html https://www.amazon.com/s/ref=nb_sb_noss?url=search-alias%3Dstripbooks&field-keywords=wireless+communication http://solutionsproj.net/software/5G-Mobile-and-Wireless-Communications-Technology.pdf	
Teaching methods	**Lecture**	+
	Group discussions at seminars	+

Assessment	**Components**	**Date/ Deadline**	**Percent (%)**
	Assignment and quizzes	During the semester	10
	Active participation	At each lesson	5
	Presentations	During the semester, 2 presentation, for each 5 points in ppt format	10
	Attendance	At each lesson	5
	Midterm exam		30
	Final exam		40
	Final		**100**

Course description	The course addresses the fundamentals of wireless communications and provides an overview of existing and emerging wireless communications networks. It covers radio propagation and fading models, fundamentals of cellular communications, multiple access technologies, and various wireless

	networks, including past and future generation networks. Simulation of wireless systems under different channel environments will be integral part of this course.
Course objectives	Wireless communications is one of the fastest growing fields in the engineering world, and a tremendous interest for this topic exists among undergraduate students. To understand the examples of wireless communication systems, paging systems, cordless telephone systems. To study the different generations of mobile networks, WAN and PAN. To understand the concepts of basic cellular system, frequency reuse, channel assignment strategies, handoff strategies, interference. To understand the FDMA, TDMA, spread spectrum multiple access. To study the Wireless Networking: Difference between wireless and fixed telephone networks, development of wireless networks. When completing this course, the students should be able to understand the basic concept of wireless system design and get familiar with various wireless networks.
Learning outcomes	What students should know by the end of the course: 1. Overview of wireless communications and systems Review of digital communications Cellular systems from 1G to 3G Wireless 4G, 5G systems 2. Radio propagation and propagation path-loss model Free-space attenuation Multipath channel characteristics Signal fading statistics Path-loss models 3. Fundamentals of cellular communications Hexagonal cell geometry Co-channel interference Cellular system design Sectoring using directional antennas 4. Multiple access techniques Frequency division multiple access (FDMA) Time division multiple access (TDMA) Code division multiple access (CDMA) Space division multiple access (SDMA) Orthogonal frequency division multiplexing (OFDM) Multicarrier CDMA (MC-CDMA) Random access methods 5. Wide-area wireless networks (WANs) GSM – IS-136 IS-95 UMTS Cdma2000 6. Long Term Evolution Technologies (LTE) OFDM MIMO channels Space Time Codes LTE Advanced 7. Other Wireless systems IEEE 802.11 WLAN (WiFi) WiMAX
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. 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	***17.09***	*Overview of Wireless Communications*	[1] / pages 27-

		History of Wireless Communications, Wireless Vision,	45/
	19.09	Technical Issues, Current Wireless Systems, The Wireless Spectrum	
2	***23.09***	*Path Loss and Shadowing* Radio Wave Propagation, Transmit and Receive Signal Models, Free-Space Path Loss,	[1] / pages 27-45/
	26.09	Ray Tracing, Simplified Path LossModel, Empirical Path LossModels.	
3	***08.10***	*Statistical Multipath Channel Models* Time-Varying Channel Impulse Response, Narrowband fadingmodels,	[1] / pages 65-91/
	10.10	Wideband FadingModels, Discrete-TimeModel, Spatio-TemporalModels	
4	***15.10***	*Capacity of Wireless Channels* Capacity in AWGN, Capacity of Flat-Fading Channels, Capacity of Frequency-Selective Fading Channels,	[1] / pages 99-117/
	17.10	Time-Invariant Channels, Time-Varying Channels *quiz 1*	
5	***22.10***	***Lecture №5***. *Digital Modulation and Detection* Signal Space Analysis, Passband Modulation Principles,	[1]/pages 127-150/
	24.10	Amplitude and Phase Modulation, FrequencyModulation, Pulse Shaping	
6	***29.10***	*Performance of Digital Modulation over Wireless Channels* AWGN Channels, Alternate *Q* Function Representation,	[1]/pages 173-193/
	31.10	Fading, Doppler Spread, Intersymbol Interference	
7	***05.11***	*Diversity* Realization of Independent Fading Paths, Diversity SystemModel, Selection Combining, Threshold Combining,	[1]/pages 205-220/
	07.11	*quiz 2* Maximal Ratio Combining, Equal-Gain Combining, Transmitter Diversity	
8	***12.11***	*Coding for Wireless Channels* Code Design Considerations, Linear Block Codes,	[1]/pages 227-246/
	14.11	Convolutional Codes, Concatenated Codes, Turbo Codes	
9		***Mid term exam***	
10	***19.11***	*Adaptive Modulation and Coding* Adaptive Transmission System, Adaptive Techniques, Variable-Rate Variable-Power MQAM, General *M*-aryModulations,	[1]/pages 279-305/
	21.11	Adaptive Techniques in Combined Fast and Slow Fading, Digital Terrestrial TV Broadcasting Systems	
11	***26.11***	*Multiple Antenna Systems* Multiple Input Multiple Output (MIMO) Systems, Space-time codes,	[1]/pages 315-320/
	28.11	*quiz 3* Smart Antennas	

12	***03.12***	*Equalization* Equalizer Types, Folded Spectrum and ISI-Free Transmission, Linear Equalizers,	[1]/pages 327-337/
	05.12	MaximumLikelihood Sequence Estimation, Decision-Feedback Equalization	
13	***10.12***	*Multicarrier Modulation* Orthogonal Frequency Division Multiplexing (OFDM),	[1]/pages 343 – 350/
	12.12	Discrete Implementation of OFDM(DiscreteMultitone), Fading across Subcarriers	
14	***17.12***	*Cellular Systems and Infrastructure-Based Wireless Networks* Cellular System Design, Frequency Reuse in Cellular Systems,	[1]/pages 395-407/
	19.12	*quiz 4* Dynamic Resource Allocation in Cellular Systems, Area Spectral Efficiency, Power Control Impact on Interference	
15	***24.12***	*Ad-Hoc Wireless Networks* Applications, Cross Layer Design, Link Design Issues, Medium Access	[1]/pages /411 – 430/
	26.12	Control Design Issues, Network Design Issues, Routing, Application Design Issues	
		Final Exam