University of Tehran
School of Electrical and Computer Engineering

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<tr><td>Course:</td><td>8101355 – Communications II</td></tr>
<tr><td>Course type:</td><td>
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<tr><td></td><td colspan="6">EE*</td><td colspan="3">CE*</td><td rowspan="2">Credit: 3</td></tr>
<tr><td></td><td>Com</td><td>E</td><td>P</td><td>B</td><td>Con</td><td>D</td><td>SW</td><td>HW</td><td>IT</td></tr>
<tr><td>Required</td><td>☒</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td>☐</td><td></td></tr>
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<tr><td>Level:</td><td>Undergraduate ■
Graduate ☐</td></tr>
<tr><td>Co-requisite(s):</td><td>None</td></tr>
<tr><td>Prerequisite(s):</td><td>Communications I (8101354)</td></tr>
<tr><td>Prerequisite by topic:</td><td>Fourier Analysis, Probability Theory and Random Variables, Analysis of Random Signals and Noise in Linear Systems, Parameters of Transmission Media</td></tr>
<tr><td>Textbook(s):</td><td>J. G. Proakis and M. Salehi, Communication Systems Engineering, 2nd ed. Prentice Hall, 2001.</td></tr>
<tr><td>Coordinator:</td><td>Ali Olfat, Associate Professor; Amirmasoud Rabiei, Assistant Professor</td></tr>
<tr><td>Goals:</td><td>The course aims to introduce students to the fundamentals of digital communications theory with more emphasis on modeling, design and performance analysis of digital communication systems. To this end, the following objectives are focused upon in this course:
1. Introducing some basic principles of information theory
2. Introducing well-known digital modulation schemes and the optimum detection strategy associated with each scheme
3. Modeling, design and performance analysis of some digital communication systems
4. Studying digital transmission of analog signals and presenting some new advances in digital communications</td></tr>
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Outcome:	Upon successful completion of this course, students should be able to 1. understand basic concepts of information theory 2. evaluate information measures such as mutual information, entropy, channel capacity and information rate 3. design and analyze a baseband digital communication system for a specified signaling scheme, bandwidth and performance measure 4. describe key concepts of digital communications such as transmitter/receiver pulse-shaping design, optimum detection, intersymbol interference (ISI) and timing synchronization 5. explain well-known digital modulation schemes, their detection strategies and their error probability performances 6. understand principles of orthogonal frequency-division multiplexing (OFDM) and ultra-wide bandwidth (UWB) communication systems
Topics:	1. **An Introduction to Information Theory** Quantifying information content associated with a message, conditional, mutual and joint information; entropy and information rate of a digital source; entropy and information rate in a digital channel, channel capacity, capacity of AWGN channel; entropy and information rate of an analog source 2. **Baseband Digital Communications** Pulse-amplitude modulation (PAM) and its power spectrum; ISI and Nyquist's first criterion for zero ISI; optimal transmitter and receiver filter design and performance analysis for PAM systems, bandwidth-power tradeoff in PAM systems; digital line coding; synchronization and eye diagram 3. **Bandpass Digital Communications** Introducing bandpass digital transmission techniques; optimal detection, matched filter and correlation receivers; signal space representation of waveforms and its application in optimum detection and performance analysis; introducing binary and *M*-ary ASK, FSK and PSK modulation as well as *M*QAM modulation schemes, coherent and noncoherent detection of digitally-modulated signals and their performance; comparing digital modulation schemes and their applications 4. **Selected Topics in Digital Communications** orthogonal frequency-division multiplexing (OFDM) its applications and advantages, implementation issues (high PAR and frequency offset sensitivity) and some solutions**; ultra-wide bandwidth (UWB) communication: channel models, signaling, multi-access schemes and selective RAKE receivers**

Computer usage:	Matlab
Assignments:	6-8 assignments
Projects:	1-2 projects
Grading:	Assignments, quizzes and projects: 15-20 % Midterm exam: 30-40 % Final exam: 40-50 %
Further readings:	[1] K. S. Shanmugam, *Digital and Analog Communication Systems*, 1st ed. John Wiley & Sons, 1979. [2] J. G. Proakis and M. Salehi, *Digital Communications*, 5th ed. McGraw-Hill, 2008. [3] J. R. Barry, E. Lee and D. G. Messerschmitt, *Digital Communication*, 3rd ed. Springer, 2003. [4] J. Cioffi, Digital Communications, (Chapters 1 through 6) available from: http://www.stanford.edu/group/cioffi/book/ [5] A. Goldsmith, Wireless Communications, Cambridge University Press, 2005. [6] B. P. Lathi and Z. Ding, *Modern Digital and Analog Communication Systems*, 4th ed. Oxford University Press, 2009
Prepared by:	Amirmasoud Rabiei
Date:	August, 2017

*EE: Electrical Engineering		CE: Computer Engineering	
Com	Communications	SW	Software
E	Electronics	HW	Hardware
P	Power	IT	Information Technology
B	Bioelectronics		
Con	Control		
D	Digital System		