University of Tehran
School of Electrical and Computer Engineering

<table>
<tr><td>Course:</td><td>810167– Advanced Theory of Communication</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="4">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></tr>
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<tr><td>Level:</td><td>Undergraduate ☐
Graduate ■</td></tr>
<tr><td>Co-requisite(s):</td><td>Stochastic Processes(8101272)</td></tr>
<tr><td>Prerequisite(s):</td><td>Communication Systems II (8101355)</td></tr>
<tr><td>Prerequisite by topic:</td><td>Probability and random processes, Fourier analysis</td></tr>
<tr><td>Textbook(s):</td><td>[1] J. G. Proakis and M. Salehi, Digital Communications, 5th Edition, McGraw-Hill, 2008.</td></tr>
<tr><td>Coordinator:</td><td>A. Olfat, Associate Professor, School of ECE</td></tr>
<tr><td>Goals:</td><td>The course presents the theoretical and practical aspects of digital communication systems and provides the mathematical background for analysis of different communication channels in the presence of noise. The students will learn the important parameters of digital transmission systems such as power, rate, bit error rate and bandwidth and the trade-offs between these parameters for different modulation schemes.</td></tr>
<tr><td>Outcome:</td><td>Upon successful completion of the course, students will be able

Obtain mathematical models for transmitted signals under different modulation schemes.
To use mathematical tools to obtain discrete probabilistic models for waveform channels.
To understand optimal decision rules and applying them for different schemes.
To compare bandwitdth, power and BER trade-offs for different signalings.
To design signals for bandwidth constrained channels.
To use dynamic programming metods such as viterbi algorithm to derive optimal receivers for linear time invariant channel models.
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	7. Design linear equalizers for linear time invariant channel models. 8. Applying diversity techniques for linear time variant channels.
Topics:	1. Review of signals and systems. 2. Review of probability and stochastic processes. 3. Signal space presentation of waveforms. 4. Digital modulation schemes. 5. Optimum receivers for AWGN channels. 6. Optimal detection and probability of error for various signaling schemes. Union bound on the probability of error for ML detection. 7. Optimum detection for non-coherent communication systems. 8. Digital transmission through band-limited channels. Linear equalizers. **9.** Communication through fading channels. Diversity techniques. Combining techniques.
Computer usage:	MATLAB
Assignments:	9 to 11 assignments
Projects:	None
Grading:	Assignments: 15% Midterm exams: 40% Final exam: 45%
Further readings:	[1] J. M. Wozencraft and I. M. Jacobs, *Principles of Communication Engineering*, Wiley, 1965. [2] J. R. Barry, D. G. Messerschmitt, and E. A. Lee, *Digital Communication,* 3rd Edition, Springer, 2003. **[3]** B. Sklar, *Digital Communications: Fundamentals and Applications*, 2nd Edition,Prentice-Hall, 2001.
Prepared by:	Ali Olfat
Date:	December 9, 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		