

UC Irvine  
EECS 241A - Digital Communication I  
Fall Quarter 2023

**Meets:** TTh 11:00 AM -12:20 PM Donald Bren Hall (DBH) 1200

**Instructor:** Ender Ayanoglu (*pronounced A-ya-no-lu*)

**Recommended (Not Required) Text:**

J. G. Proakis, M. Salehi, *Digital Communications*, 5<sup>th</sup> Edition, McGraw-Hill, 2008 (four former editions by Proakis).

**Useful Texts:**

1. A. Leon-Garcia, *Probability and Random Processes for Electrical Engineering*, 2<sup>nd</sup> Ed., Addison Wesley Longman, 1994.
2. A. Papoulis. *Probability, Random Variables, and Stochastic Processes*, 3<sup>rd</sup> Ed., McGraw-Hill, 1991 (or former or 4<sup>th</sup> Ed. with Pillai).
3. S. Haykin, *Digital Communication Systems*, Wiley, 2014.
4. J. Barry, E. A Lee, D. G. Messerschmitt, *Digital Communication*, 3<sup>rd</sup> Ed., Kluwer, 2004 (two former editions by Lee and Messerschmitt).
5. J. M. Cioffi, *EE379A Course Reader*, Stanford University. Available online.
6. U. Madhow, *Fundamentals of Digital Communication*, Cambridge, 2008.
7. W. Stark, *Introduction to Digital Communications*, Cambridge, 2023.
8. M. K. Simon, S. M. Hinedi, W. C. Lindsey, *Digital Communication Techniques: Signal Design and Detection*, Prentice-Hall, 1993.
9. F. Xiong, *Digital Modulation Techniques*, Artech House, 2000.
10. J. M. Wozencraft, I. M. Jacobs, *Principles of Communication Engineering*, Wiley, 1965.
11. H. L. Van Trees, *Detection, Estimation, and Modulation Theory, Part I*, Wiley, 1968.

**Prerequisites:**

A *strong* background in continuous and discrete linear signals and systems, Fourier transforms, probability theory, and multidimensional calculus is highly necessary. An undergraduate course in communications is useful.

**Covers:**

Random signals, response of linear systems to random signals, vector and signal spaces, maximum a posteriori and maximum likelihood detection, optimum receivers, digital modulation: PAM, QAM, PSK, FSK, MSK, DPSK, orthogonal, biorthogonal, and simplex signaling, coherent and noncoherent detection, probability of error and power spectra analysis of digital modulation techniques, maximum likelihood sequence detection (Viterbi algorithm).

**Grading:**

15% Homework (problem sets, course evaluation), 35% Midterm, 50% Final.

**Policies:**

Midterm and final are open book and notes. Homeworks will be graded randomly and on the basis of a mixture of effort and correctness. It is recommended that you turn in every homework and make it your own effort.

**Course Schedule**

<b>Lecture</b>	<b>Date</b>	<b>Subject</b>	<b>Notes Pages</b>	<b>Proakis 4th Ed. Section</b>	<b>Proakis 5th Ed. Section</b>	<b>Due</b>
1	9/28	Introduction, Random Variables	1.1-2.4	2.1-2.1.3	2.3	
2	10/3	Averages, Characteristic Function, Gaussian Density	2.5-2.11	2.1.3-2.1.4		
3	10/5	Multivariate Gaussian Density, Central Limit Theorem	2.12-2.18	2.1.6	2.5-2.6	
4	10/10	Random Processes	3.1-3.8	2.2	2.7	
5	10/12	Bandpass Signals	3.9-4.7	4.1	2.1	<b>HW1</b>
6	10/17	Vector Space	4.8-5.3	4.2.1	2.2-1	
7	10/19	Signal Space, Orthogonal Signals	5.4-6.2	4.2.2-4.2.3	2.2-2 - 2.2-4	<b>HW2</b>
8	10/24	Optimum Receivers	6.3-6.9	5.1.1-5.1.2	4.1-4.2	
9	10/26	Maximum Likelihood Detection, Binary Modulation	6.10-7.2	5.1.3, 4.3.1, 5.2.1	3.1	<b>HW3</b>
10	10/31	Pulse Amplitude Modulation	7.3-7.8	5.2.6	3.2-1, 4.3-1	
11	11/2	Quadrature Amplitude Modulation	7.9-7.14	5.2.9	3.2-3, 4.3-3	<b>HW4</b>
12	11/7	<b>MIDTERM</b>				
13	11/9	Phase Shift Keying	7.15-7.20	5.2.7	3.2-2, 4.3-2	
14	11/14	Orthogonal, Biorthogonal, and Simplex Signaling	8.1-8.6	5.2.2-5.2.4	3.2-4, 4.4	
15	11/16	Frequency Shift Keying, Minimum Shift Keying	8.7-9.5			
16	11/21	Calculation of Power Spectra	10.1-10.4			
	11/23	Thanksgiving, No Class				
17	11/28	Power Spectra of Digital Modulation Techniques	10.5-10.10			
18	11/30	Maximum Likelihood Sequence Estimation	11.1-11.6	5.1.4	4.8	<b>HW6</b>
19	12/5	Maximum Likelihood Sequence Estimation, Continued				
20	12/7	Review				<b>HW7</b>

**FINAL: December 12, 2023 10:30 AM-12:30 PM**

**HW5 will not be collected. Its solutions will be available 11/2.**