UC Irvine
EECS 241A - Digital Communication I
Fall Quarter 2024

Meets: TTh 11:00 AM -12:20 PM Social Science Trailer 101

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

Recommended (Not Required) Text:
J. G. Proakis, M. Salehi, *Digital Communications*, 5th Edition, McGraw-Hill, 2008 (four former editions by Proakis).

Useful Texts:
1. A. Leon-Garcia, *Probability and Random Processes for Electrical Engineering,* 2nd Ed., Addison Wesley Longman, 1994.
2. A. Papoulis. *Probability, Random Variables, and Stochastic Processes,* 3rd Ed., McGraw-Hill, 1991 (or former or 4th Ed. with Pillai).
3. S. Haykin, *Digital Communication Systems,* Wiley, 2014.
4. J. Barry, E. A Lee, D. G. Messerschmitt, *Digital Communication,* 3rd 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

Lecture	Date	Subject	Notes Pages	Proakis 4th Ed. Section	Proakis 5th Ed. Section	Due
1	9/26	Introduction, Random Variables	1.1-2.4	2.1-2.1.3	2.3	
2	10/1	Averages, Characteristic Function, Gaussian Density	2.5-2.11	2.1.3-2.1.4		
3	10/3	Multivariate Gaussian Density, Central Limit Theorem	2.12-2.18	2.1.6	2.5-2.6	
4	10/8	Random Processes	3.1-3.8	2.2	2.7	
5	10/10	Bandpass Signals	3.9-4.7	4.1	2.1	**HW1**
6	10/15	Vector Space	4.8-5.3	4.2.1	2.2-1	
7	10/17	Signal Space, Orthogonal Signals	5.4-6.2	4.2.2-4.2.3	2.2-2 - 2.2-4	**HW2**
8	10/22	Optimum Receivers	6.3-6.9	5.1.1-5.1.2	4.1-4.2	
9	10/24	Maximum Likelihood Detection, Binary Modulation	6.10-7.2	5.1.3, 4.3.1, 5.2.1	3.1	**HW3**
10	10/29	Pulse Amplitude Modulation	7.3-7.8	5.2.6	3.2-1, 4.3-1	
11	10/31	Quadrature Amplitude Modulation	7.9-7.14	5.2.9	3.2-3, 4.3-3	**HW4**
12	11/5	**MIDTERM**				
13	11/7	Phase Shift Keying	7.15-7.20	5.2.7	3.2-2, 4.3-2	
14	11/12	Orthogonal, Biorthogonal, and Simplex Signaling	8.1-8.6	5.2.2-5.2.4	3.2-4, 4.4	
15	11/14	Frequency Shift Keying, Minimum Shift Keying	8.7-9.5			
16	11/19	Calculation of Power Spectra	10.1-10.4			
17	11/21	Power Spectra of Digital Modulation Techniques	10.5-10.10			
18	11/26	Maximum Likelihood Sequence Estimation	11.1-11.6	5.1.4	4.8	**HW6**
	11/28	Thanksgiving, No Class				
19	12/3	Maximum Likelihood Sequence Estimation, Continued				
20	12/5	Review				**HW7**

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

HW5 will not be collected. Its solutions will be available 10/31.