

University of Illinois at Urbana-Champaign
Department of Electrical and Computer Engineering

ECE 359: COMMUNICATIONS I

Fall 2000

Problem Set 11

**Narrowband Noise, Noise Analysis of Analog Modulation Systems,
Pulse Amplitude Modulation, Pulse Code Modulation**

Issued: Thursday, November 30th.

Due: Never.

Reading from Lathi: Narrowband Noise: Chapter 11, Section 11.5; Noise Analysis of Analog Modulation Systems: Chapter 12, Section 12.2–12.3; Sampling and Pulse Amplitude Modulation: Chapter 6, Section 6.1 and Chapter 7, Section 7.3; Quantization and Pulse Code Modulation: Chapter 6, Section 6.2.

Reading from Haykin: Narrowband Noise: Chapter 4, Sections 4.14–4.16; Noise Analysis of Analog Modulation Systems: Chapter 5, Sections 5.1–5.3 and 5.5–5.7; Sampling and Pulse Amplitude Modulation: Chapter 6, Sections 6.1–6.4; Quantization and Pulse Code Modulation: Chapter 6, Sections 6.7–6.10.

Announcement: The Final Exam will be held on Tuesday, December 12th, from 1:30pm to 4:30pm in 161 Everitt Laboratory. The exam will cover all material from the beginning of the term. For the exam, you can bring *three* 8.5 × 11-inch double-sided sheets of *handwritten* notes. Calculators are allowed but will not be necessary.

Problem 11.1

Problem 11.5-1 from Lathi, p. 530.

Problem 11.2 (Optional)

Problem 11.5-2 from Lathi, p. 530.

Problem 11.3

Problem 11.5-3 from Lathi, p. 530.

Problem 11.4 (Optional)

Consider a bandpass Gaussian noise process $N(t)$ with zero mean and power spectral density

$$S_{NN}(\omega) = \begin{cases} \frac{N_0}{2}, & \omega_c - 2\pi B \leq \omega \leq \omega_c + 2\pi B, \quad -\omega_c - 2\pi B \leq \omega \leq -\omega_c + 2\pi B, \\ 0, & \text{otherwise.} \end{cases}$$

Find the probability density function of a sample of the envelope of $n(t)$, i.e., find $f_E(e)$ of the random variable $E = c(t)$, where $c(t)$ is the envelope of the band-limited random process $N(t)$.

Problem 11.5

Problem 12.2-1 from Lathi, p. 573.

Problem 11.6

Problem 12.3-1 from Lathi, pp. 573–574.

Problem 11.7

Problem 6.1-2 from Lathi, p. 289.

Problem 11.8

Problem 6.1-5 from Lathi, p. 290.

Problem 11.9

Problem 7.3-4 from Lathi, pp. 349–350.

Problem 11.10

Problem 6.2-2 from Lathi, p. 289 (in part (d), ignore the question about the minimum bandwidth required).

Problem 11.11

Problems 6.2-6 from Lathi, p. 292.