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

ECE 459: Communications I

Fall 2005

Problem Set 10

Pulse Amplitude Modulation, Pulse Code Modulation

Issued: Thursday, December 8th. **Due:** Never.

Reading from Lathi: 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.

Announcement: The Final Exam will be held on Saturday, December 17th, from 1:30pm to 4:30pm in 165 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. A copy of an old final exam is available from the course website.

Problem 10.1

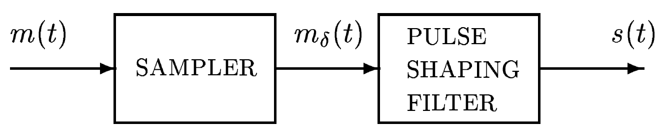
Problem 6.1-1 from Lathi, p. 289.

Problem 10.2

Problem 6.1-5 from Lathi, p. 290.

Problem 10.3

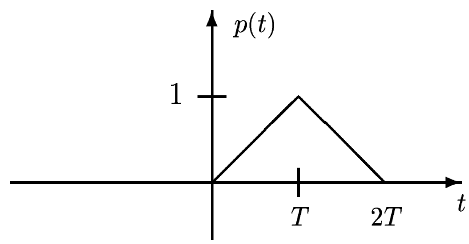
Consider the pulse amplitude modulation (PAM) scheme shown below.



The output of the sampler is given by

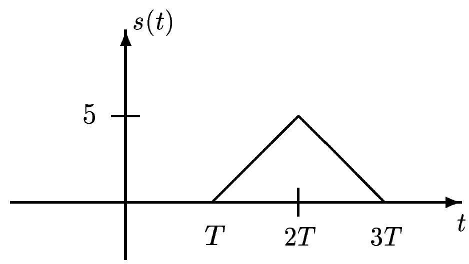
$$m_\delta(t) = \sum_{k=-\infty}^{+\infty} m(kT)\delta(t - kT)$$

(where T is the sampling period) and the output of the pulse shaping filter is given by $s(t) = m_\delta(t) * p(t)$, where $p(t)$ is the following pulse.



(a) Suppose that $m(t) = \cos 2\pi t$ and that the sampling period is $T = \frac{1}{8}$s. Sketch the resulting transmitted signal $s(t)$ for $0 \le t \le 1$s.

(b) Suppose instead that the message signal $m(t)$ is bandlimited with bandwidth W rad/s and that sampling is performed exactly at the Nyquist rate of $m(t)$ (i.e., $T = \frac{2\pi}{2W}$). Furthermore, we are given that the transmitted signal $s(t)$ looks as follows.



Find the corresponding message signal $m(t)$. Is your answer unique?

Problem 10.4

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

Problem 10.5

Problem 6.2-1 from Lathi, p. 291.

Problem 10.6

Problems 6.2-6 from Lathi, p. 292.