Homework 4

Assigned: Monday, April 24, 2006
Due: Monday, May 1, 2006

Reading Assignment: Proakis & Salehi, Chapter 7 (7.5, 7.6.1), Chapter 8: (8.1, 8.3)

1. $P(f) = \left[ \frac{\sin(2\pi f T)}{2\pi f T} \right]^2$, for all real $f$, is the power spectral density function. What is the corresponding autocorrelation function?

2. A communication system transmits binary data at 64kbit/sec. The data are transmitted using PAM with a raised cosine spectrum. Calculate the bandwidth required for transmission for roll off factors 0.3, 0.5, 1.0 in the following cases:
   (a) Data are transmitted using binary PAM.
   (b) Data are transmitted using 16-level PAM by grouping each set of 4 consecutive bits into one symbol.

3. Find and sketch the impulse response of the matched filter that maximizes the ratio of the signal power to the noise power for the following pulse shapes:
   (a) $g(t) = \begin{cases} t & \text{for } 0 \leq t \leq T \\ 0 & \text{otherwise} \end{cases}$
   (b) $g(t) = \begin{cases} e^{-t} & \text{for } 0 \leq t \leq T \\ 0 & \text{otherwise} \end{cases}$
   (c) $g(t) = \begin{cases} \sin\left(\frac{2\pi t}{T}\right) & \text{for } 0 \leq t \leq T \\ 0 & \text{otherwise} \end{cases}$

   For each case, Compute the value of $p(T)$ produced by sampling the matched filter output at time $T$, the output noise power $E[\hat{n}^2(t)]$, and the signal to noise ratio at the output of the matched filter.

4. (a) Show that $\text{sinc}(t)$ is a Nyquist pulse shape for symbol period $T_s = 1$.
   (b) Show that $\text{sinc}^2(t)$ is a Nyquist pulse shape for symbol period $T_s = 1$. 