HOMEWORK ASSIGNMENT 8

Reading: Text, Section 4.2, 4.3, 4.4 and Handouts #11,13,14

Due Date: April 3, 2003 (in class)

1. Give an example of two processes $X(t)$ and $Y(t)$ for which the cross-correlation function is a function only of τ, but for which either $X(t)$ or $Y(t)$ are not WSS.

2. A WSS process $X(t)$ with power spectral density $S_X(f) = 10\Pi(\frac{f}{4})$ is passed through a LTI system with transfer function $H(f) = \Pi(\frac{f}{2})$. Let $Y(t)$ denote the output.

   Find $S_Y(f)$, and from it find $R_Y(\tau)$.

3. A white noise process $X(t)$ with power spectral density $S_X(f) = \frac{N_0}{2}$ is input to linear system with impulse response $h(t) = e^{-t}u(t)$. Let $Y(t)$ denote the output.

   Find $S_Y(f)$, and from it find $R_Y(\tau)$.

4. Let $X(t)$ be a white *Gaussian* noise process with power spectral density $S_X(f) = \frac{N_0}{2}$. Let the random variable Y be given by

$$Y = \int_0^T X(t)dt$$

   We know that Y is also a Gaussian random variable.

   Find the mean and variance of Y.

   Hints: You are allowed to take the expectation inside integrals (why?). For computing the variance, write Y^2 as

$$Y^2 = \int_0^T X(t)dt \int_0^T X(t')dt' = \int_0^T \int_0^T X(t)X(t')dtdt'$$

5. A baseband communications channel has a flat frequency response with $H_c(\omega) \approx 10^{-3}$ over the signal band. The message signal PSD is $S_M(\omega) = \beta\Pi(f/8000)$, i.e., the message has a flat spectrum over a 4 kHz bandwidth. The channel noise PSD is $\frac{N_0}{2} = 10^{-8}$. The baseband SNR $\overline{\Gamma}$ is required to be at at least 30 dB.

   What is the minimum transmit power $P_{\rm s,t}$ required? Also find the corresponding value of β.