EE 511 Problem Set 8

1. Let X_t be a W.S.S. random process and let $Y_t = X_t \cos 2\pi f_c t$ and $Z_t = X_t \cos(2\pi f_c t + \Theta)$ where Θ is uniformly distributed in $[0, 2\pi]$ and independent of X_t. Show that Y_t is wide-sense cyclostationary and Z_t is W.S.S.

2. Let X_t (transmitted signal of a communication system) be a random process defined as follows:

$$X_t = \sum_{n=-\infty}^{\infty} A_n p(t - nT - T_d),$$

where A_n are binary random variables (that take values +1 or -1 with equal probability) such that $E[A_n A_{n+k}] = R_A(k)$, T_d is a random variable independent of A_n for all n and is uniform in $[0, T]$, $p(t)$ is the pulse shape used for transmission, and T is a constant.

a) Determine the auto-correlation of X_t in terms of $R_A(k)$ and the pulse shape $p(t)$. b) Let $p(t)$ be a rectangular pulse shape of duration $2T$ and amplitude A. Let $R_A(k) = 0$ for all $k \neq 0$. Sketch $R_X(\tau)$. c) Let $p(t)$ be a rectangular pulse shape of duration T and amplitude A. Let B_n be an i.i.d sequence of binary random variables (that take values +1 or -1 with equal probability) and $A_n = B_n + B_{n-1}$. Sketch $R_X(\tau)$. d) Let B_n be an i.i.d sequence of binary random variables (that take values +1 or -1 with equal probability) and $A_n = 2B_n + B_{n-1}$. Determine and sketch $R_X(\tau)$.