GEORGIA INSTITUTE OF TECHNOLOGY
School of Electrical and Computer Engineering

ECE 4260A

Problem Set #7

Date assigned: March 3, 2017
Date due: March 10, 2017

Reading: Read Chapter 8 in Stark and Woods.

Problem 7.1:

(a) A discrete-time random process has sample functions of the form: $X[n] = A$ where A is a Gaussian random variable of mean 2 and variance 1.

(i) Find the mean of $X[n]$.

(ii) Find the power in $X[n]$.

(iii) Find $R_X[m_1, m_2]$, the autocorrelation function of $X[n]$.

(iv) Is $X[n]$ deterministic or not? Justify your answer.

(b) $W[n]$ is zero mean discrete-time WSS white noise with spectral height of 1.

(i) What is its power?

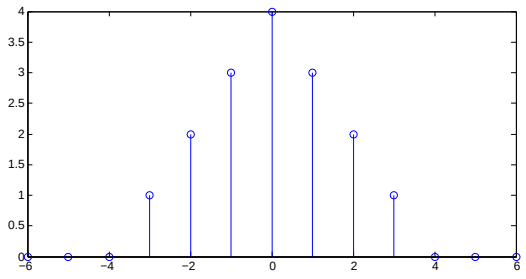
$W[n]$ is put through an ideal lowpass filter with gain 1 and cutoff $\pi/3$ radians. The filter's corresponding impulse response is $\frac{\sin \frac{\pi}{3} n}{\pi n}$. The output is $Y[n]$.

(ii) Find $R_{YY}[m]$.

(iii) Find the variance of $Y[n]$.

(iv) Find $R_{YW}[m]$

(c) $G[n]$ is stationary, zero mean, and has autocorrelation function as sketched below:



(i) If $G[n]$ is Gaussian, find the joint PDF for $[G[1], G[2]]$

(ii) Find $\frac{1}{2\pi}\int_{-\pi}^{\pi} S_G(\omega)d\omega$ where $S_G(\omega)$ is the power spectral density of $G[n]$.

(iii) $G[n]$ is input to a system with impulse response equal to $\delta[n-7]$ (i.e., a delay by 7). The output is $F[n]$. Find $R_{GF}[m]$.

(d) $J[n]$ and $K[n]$ are independent, zero mean stationary random processes. $R_{JJ}[m] = 2e^{-|m|}$; $R_{KK}[m] = 3e^{-(m^2)}$.

(i) Find the power in $3J[n] - 2K[m]$.

(ii) Let $L[m] = J[m] + K[m]$. Find $R_{LJ}[m]$.

(iii) $J[n]$ was obtained by passing unit spectral height white noise through a filter. Find a possible impulse response for that filter.

Problem 7.2:

Work problem 8.22 in Stark and Woods.

Problem 7.3:

Work problem 8.24 in Stark and Woods.

Problem 7.4:

Work problem 8.26 in Stark and Woods.

Problem 7.5:

Work problem 8.32 in Stark and Woods.

Problem 7.6:

Work problem 8.36 in Stark and Woods.