2008 Quals J. Cioffi

TOTAL - 10 pts

Random Variables, Processes and Linear Systems - 10 pts

A complex random variable x takes on the 4 values $\pm 1 \pm j$ with equal probability ($j = \sqrt{-1}$).

a). What is the mean value of x? (.5 pt)

b). What is the variance of x ? (1 pts)

Independent selections of this random variable at different discrete points in time, k, form the stationary random process x_k. Another random process is computed according to

$$y_k = \frac{x_k + x_{k-1} + x_{k-2} + x_{k-3}}{4}$$

c). What does the process y_k approximate? (.5 pt)

d). Find $E[y_k]$. (1 pt)

e). Find the variance of y_k (1 pt)

f). How many distinct values are there for the random process y_k ? (1 pt)

(hint you may want to consider each of real and imaginary components)

g). What is the autocorrelation function of x_k, $r_{x,k} = E[x_n \cdot x^*_{n-k}]$? (1 pt)

h). What is the autocorrelation function of y_k ? (2 pts)

i). What is the probability distribution of y_k ? (2 pts)

(hint, see hint in f).