TD 5

Exercises on: Transmission of random signals in linear system

5.1 Exercise 1

The input to a linear system with $h(t) = 10e^{-10t}U(t)$ is a random signal $X(t) = M + cos(20t + \theta)$,where,$M$is a normal process,and $E\{M\} = 5$, and θ is a random variable uniformly distributed in the interval $[0, 2\pi]$. $Y(t)$ is the output of the system.

a) Find $Y(t)$.
b) Find the mean of $Y(t)$

5.2 Exercise 2

Given a random process $X(t)$ with zero Mean, auto-correlation function $R_X(\tau)$. The process $Y(t)$ is the output of the system shown in the Fig.5-1 with input $X(t)$. Find $R_Y(\tau)$ and $S_Y(\omega)$.

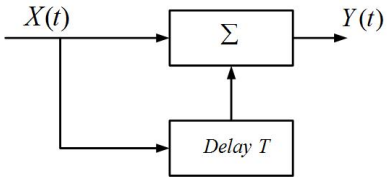

Fig. 5-1

5.3 Exercise 3

The process $X(t)$ is WSS with $E\{X(t)\} = 5$ and $R_X(\tau) = 25 + 4e^{-2|\tau|}$. If $Y(t) = 2X(t) + 3X'(t)$, find η_Y, $R_Y(\tau)$, and $S_Y(\omega)$.

5.4 Exercise 4

Given an RC-low pass circuit shown in the Fig.5-2 with the input $X(t)$, and $X(t)$ is white noise with auto-correlation function $R_X(\tau) = \frac{N_0}{2}\delta(\tau)$.

a) Find the auto-correlation function of output $Y(t)$.
b) Find the average output power.
c) Find the cross-correlation function $R_{XY}(\tau)$ and $R_{YX}(\tau)$.

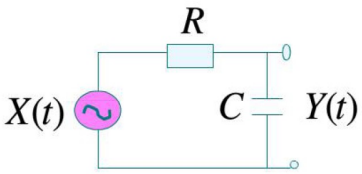

Fig. 5-2