COLLEGE OF ENGINEERING & TECHNOLOGY

Department : Electronics & Communications Engineering

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Course : Communication Systems II

Course Code : EC 421

Sheet (8)- Random Processes -I

1-

a. Random process $X(t, f) = \sin(2\pi ft)$

$$P(f) = \begin{cases} 1/w & 0 \leq f \leq w \\ 0 & \text{elsewhere} \end{cases}$$

Show that $X(t, f)$ is non-stationary

b. Random process $X(t, a) = a\cos(2\pi f_c t)$

$$P(a) = \begin{cases} 1 & 0 \leq a \leq 1 \\ 0 & \text{elsewhere} \end{cases}$$

Determine whether $X(t, a)$ is stationary or not and check its ergodicity

c. Random process $= a\cos(2\pi f_c t + \theta)$

$$P(\theta) = \begin{cases} 1/2\pi & 0 \leq \theta \leq 2\pi \\ 0 & \text{elsewhere} \end{cases}$$

Determine whether $X(t, \theta)$ is stationary or not and check its ergodicity

2- A random process $X(t)$ is defined by

$$X(t) = A\cos(2\pi f_c t)$$

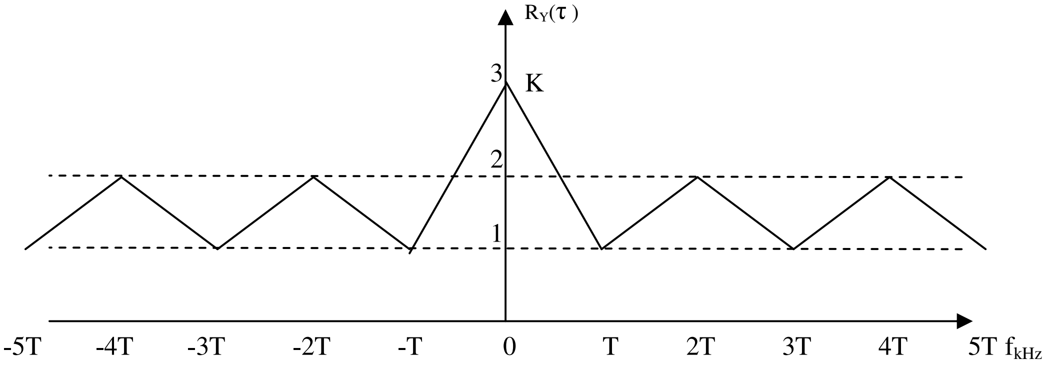
Where A is a gaussian distributed random variable of zero mean and variance σ_A^2. This random process is applied to an ideal integrator, producing the output

$$Y(t) = \int_0^t X(\tau)\, d\tau$$

(a) Determine the probability density function of the output $Y(t)$ at a particular time t_k

(b) Determine whether or not $Y(t)$ is stationary and if so whether or not $Y(t)$ is ergodic

3- A random process Y(t) consists of a dc component of √3/2 volts, a periodic component g(t) and a random component X(t). The autocorrelation function of Y(t) is shown below.



(a) What is the average power of the periodic component g(t) ?
(b) What is the average power of the random component X(t) ?

4- The power spectral density of a random process X(t) is shown below.

(a) Determine and sketch the autocorrelation function $R_x(\tau)$ of X(t)
(b) What is the dc power contained in X(t)?
(c) What is the ac power contained in X(t)?