

**Department of Mathematics**

**Probability and Random Processes  
Tutorial Sheet 13**

**15B11MA301  
C201.5**

**Random Process**

1. If the autocorrelation function of a WSS process is  $R(\tau) = \rho e^{-\rho|\tau|}$ , Show that its spectral density is

$$S(\omega) = \frac{2}{1 + \left(\frac{\omega}{\rho}\right)^2}$$

2. Find the power density spectral of a stationary process  $\{X(t)\}$  with

$$R_{XX}(\tau) = \sigma^2 e^{-\alpha|\tau|}.$$

Ans:

$$= \frac{2\sigma^2\alpha}{\alpha^2 + \omega^2}$$

3. A WSS noise process  $N(t)$  has an ACF  $R_{NN}(\tau) = \rho e^{-3|\tau|}$ , where  $\tau$  is a constant. Find its power spectrum.

Ans:

$$= \frac{6\rho}{9 + \omega^2}$$

4. Find autocorrelation function  $R(\tau)$  of a random process if the power spectral density of random process  $\{X(t)\}$  is given by

$$S(\omega) = \begin{cases} A, & |\omega| \leq \beta \\ 0, & |\omega| > \beta \end{cases}$$

Ans:

$$= \frac{A}{\pi} \left( \frac{\sin \beta\tau}{\tau} \right)$$

5. Find the spectral density of random process  $\{X(t)\}$  whose autocorrelation is

$$R(\tau) = \begin{cases} -1, & -3 < \tau < 3 \\ 0, & \text{otherwise} \end{cases}$$

Ans:

$$= \frac{-2 \sin 3\omega}{\omega}$$

6. If  $\{X(t)\}$  is a constant random process with  $R_{XX}(\tau) = m^2$ ,  $\forall \tau$  where  $m$  is a constant, show that the spectral density of the process is  $S(\omega) = 2\pi m^2 \delta(\omega)$ .

7. Find the spectral density of random process  $\{X(t)\}$  whose autocorrelation is  $R_{XX}(\tau) = e^{-\alpha|\tau|} \cos \beta\tau$ .

Ans:

$$= \frac{\alpha}{\alpha^2 + (\omega - \beta)^2} + \frac{\alpha}{\alpha^2 + (\omega + \beta)^2}$$