Assignment 13

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Question : Show that if ϕ is a random variable with $\phi(\lambda) = E\{e^{f\lambda\phi}\}$ and $\phi(1) = \phi(2) = 0$, then the process $x(t) = \cos(wt + \phi)$ is WSS. Find $E\{x(t)\}$ and $R_x(\tau)$ if ϕ is uniform in the interval $(-\pi, \pi)$

Solution :

From

$$\phi(1) = \phi(2) = 0 \tag{1}$$

we can conclude that

$$E\{\cos\phi\} = E\{\sin\phi\} = E\{\cos 2\phi\} = E\{\sin 2\phi\} = 0 \tag{2}$$

$$\implies E\{x(t)\} = \cos(wt)E\{\cos\phi\} - \sin(wt)E\{\sin\phi\} \tag{3}$$

And using the result

$$2cos[\omega(t+\tau)+\phi]\cos(\omega t+\phi) = \cos(\omega\tau+\phi)+\cos(2\omega t+\omega\tau+2\phi) \tag{4}$$

$$2R_x(\tau) = \cos(\omega\tau) \tag{5}$$

If ϕ is uniform in $(-\pi, \pi)$, then

$$\phi(\lambda) = \frac{\sin(\pi\omega)}{\pi\omega} \; and \; \phi(1) = \phi(2) = 0 \tag{6}$$