

Assignment 12

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Outline

- 1 Question
- 2 Solution (a)
- 3 Solution (b)
- 4 Solution(b)..
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Question

9-31(Papoullis):

Show that if

$$S = \int_0^{10} x(t) dt \text{ then } E(S^2) = \int_{-10}^{10} (10 - |\tau|) R_X(\tau) d\tau$$

Find the mean and variance of S if $E(x(t)) = 8, R_X(\tau) = 64 + 10^{-2|\tau|}$

Solution (a)

Solution (a)

The moment of S is equal to moments of (Since $x(t)$ is WSS)

$$Z = \int_{-5}^5 x(t) dt \quad (1)$$

$$\Rightarrow E(S^2) = \int_{-5}^5 \int_{-5}^5 R_X(t_1 - t_2) dt_1 dt_2 \quad (2)$$

$$\Rightarrow E(S^2) = \int_{-10}^{10} (10 - |\tau|) R_X(\tau) d\tau \quad (3)$$

Solution (b)

Solution (b)

$$s = \int_0^{10} x(t) dt \quad (4)$$

$$\Rightarrow E(s) = \int_0^{10} E(x(t)) dt \quad (5)$$

$$\text{Given } E(x(t)) = 8 \quad (6)$$

$$\Rightarrow \boxed{E(s) = 80} \quad (7)$$

Contd. . .

Contd

$$\text{Var}(s) = E(S - E(S))^2 = E(S^2) - E(S)^2 \quad (8)$$

$$\sigma^2 = 2 \int_0^{10} (10 - \tau)(64 + 10e^{-2\tau})d\tau - 80^2 \quad (9)$$

$$\Rightarrow \boxed{\sigma^2 \approx 9.5} \quad (10)$$