

AI1110 Assignment 10

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June 16, 2022

Question(Papoulis Exercise 11.9)

Find the mean of the integral

$$X(\omega) = \int_{-a}^a [5 \cos 3t + v(t)] e^{-j\omega t} dt$$

if $E[v(t)] = 0$

Solution

$$X(\omega) = \int_{-a}^a [5 \cos 3t + v(t)] e^{-j\omega t} dt \quad (1)$$

$$= \int_{-a}^a 5 \cos(3t) e^{-j\omega t} dt + \int_{-a}^a v(t) e^{-j\omega t} dt \quad (2)$$

$$= \int_{-a}^a 5 \cos(3t) e^{-j\omega t} dt + 0 \quad (3)$$

$$= 5 \left(\frac{3 \sin(3t)}{(-j\omega)^2 + 9} - \frac{j\omega \cos(3t)}{(-j\omega)^2 + 9} \right) e^{-j\omega t} \Big|_{-a}^a \quad (4)$$

Solution(Contd.)

Solving eqn.4 we get,

$$E\{X(\omega)\} = \frac{5 \sin a(\omega - 3)}{\omega - 3} + \frac{5 \sin a(\omega + 3)}{\omega + 3} \quad (5)$$