

# Assignment-7 : Papoullis Chapter 9

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# Outline

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# Question

## Problem 9.52

Given a random variable  $\omega$  with density  $f(\omega)$  such that  $f(\omega) = 0$  for  $|\omega| > \pi$ , we form the process  $x[n] = Ae^{jn\omega}\pi$ . Show that  $S_\omega = 2\pi A^2 f(\omega)$  for  $|\omega| < \pi$ .

# Solution

Solution:-

if  $x[n] = Ae^{jn\omega T}$  then,

$$R_x[m] = A^2 E[e^{j(m+n)\omega T} e^{-jn\omega T}]$$

$$\implies A^2 \int_{-\sigma}^{\sigma} e^{jn\omega T} f(\omega) d\omega$$

But from  $S(e^{j\omega}) = R[0] + 2\sum_{m=0}^{\infty} R[m] \cos m\omega$

$$R[m] = \frac{1}{2\sigma} \int_{\sigma}^{\sigma} S_x(\omega) e^{jn\omega T} d\omega$$

$$\text{Hence, } A^2 f(\omega) = S_x(\omega)/2\sigma$$