

# GATE Assignment 4

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Download all latex codes from

<https://github.com/sujal100/EE3900/blob/main/Gate4/Gate4.tex>

## 1 PROBLEM

**(GATE EC 1997 - Q3.7)** The power spectral density of a deterministic signal is given by  $\left[\sin(f)/f^2\right]$  where  $f$  is frequency. The autocorrelation function of this signal in the time domain is

- (a) a rectangular pulse
- (b) a delta function
- (c) a sine pulse
- (d) a triangular pulse

## 2 SOLUTION

The Fourier transform of autocorrelation function

$$R_X(\tau) = \frac{1}{2\pi} \int_{-\infty}^{\infty} F(\omega) F^*(\omega) e^{j\omega\tau} d\omega \quad (2.0.1)$$

$$R_X(\tau) = \frac{1}{2\pi} \int_{-\infty}^{\infty} |F(\omega)|^2 e^{j\omega\tau} d\omega \quad (2.0.2)$$

$$R_X(\tau) = F^{-1} \left[ |F(\omega)|^2 \right] \quad (2.0.3)$$

$$= \text{Fourier inverse of power spectral density} \quad (2.0.4)$$

The auto correlation function and power spectral density make the Fourier transfer pair

$$R_X(\tau) \leftrightarrow G_X(\omega)$$

$$R_X(\tau) = F^{-1} \left[ \frac{\sin f}{f} \right]^2$$

Inverse Fourier transform of square of sinc function is always a triangular signal in time domain.