

# GATE Assignment 2

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[https://github.com/srikan-p/EE3900/tree/main/GATE\\_Assignment2/codes](https://github.com/srikan-p/EE3900/tree/main/GATE_Assignment2/codes)

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## PROBLEM

(GATE EC-2006 Q.14) Let  $x(t) \leftrightarrow X(j\omega)$  be Fourier Transform pair. The Fourier Transform of the signal  $x(5t - 3)$  in terms of  $X(j\omega)$  is given as

- (A)  $\frac{1}{5}e^{-\frac{j3\omega}{5}}X\left(\frac{j\omega}{5}\right)$
- (B)  $\frac{1}{5}e^{\frac{j3\omega}{5}}X\left(\frac{j\omega}{5}\right)$
- (C)  $\frac{1}{5}e^{-j3\omega}X\left(\frac{j\omega}{5}\right)$
- (D)  $\frac{1}{5}e^{j3\omega}X\left(\frac{j\omega}{5}\right)$

## SOLUTION

By the time scaling property of Fourier transform,

$$x(\alpha t) \xrightarrow{\mathcal{F}} \frac{1}{|\alpha|} X\left(\frac{j\omega}{|\alpha|}\right) \quad (0.0.1)$$

$$x(5t) \xrightarrow{\mathcal{F}} \frac{1}{5} X\left(\frac{j\omega}{5}\right) \quad (0.0.2)$$

By the time shifting property of Fourier transform,

$$x(t - t_0) \xrightarrow{\mathcal{F}} e^{-j\omega t_0} X(j\omega) \quad (0.0.3)$$

$$x\left(5\left(t - \frac{3}{5}\right)\right) \xrightarrow{\mathcal{F}} \frac{1}{5} e^{-\frac{j3\omega}{5}} X\left(\frac{j\omega}{5}\right) \quad (0.0.4)$$

Let  $x(t) = \text{rect}(t)$ .

$$X(j\omega) = \text{Sa}\left(\frac{\omega}{2}\right) \quad (0.0.5)$$

For  $x(t) = \text{rect}(5t - 3)$

$$\frac{1}{5} e^{-\frac{j3\omega}{5}} X\left(\frac{j\omega}{5}\right) = \frac{1}{5} e^{-\frac{j3\omega}{5}} \text{Sa}\left(\frac{\omega}{10}\right) \quad (0.0.6)$$

The correct option is (A).

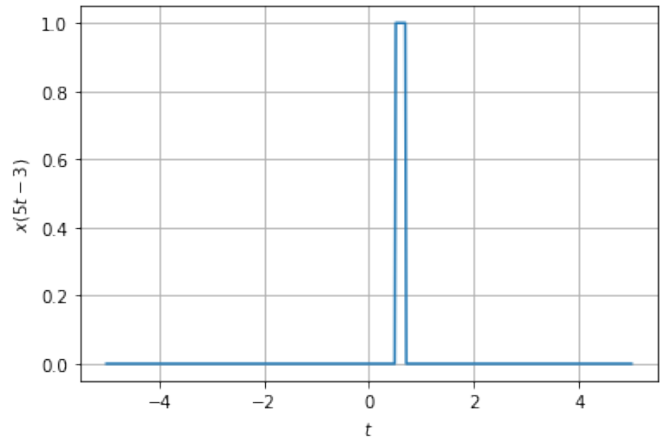


Fig. 4: Plot of  $\text{rect}(5t-3)$

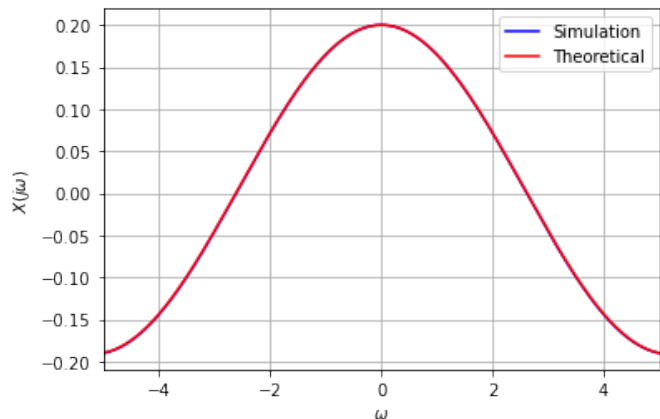


Fig. 4: Fourier transform Simulation v/s Theoretical