

GATE Assignment 2

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Download all python codes from

https://github.com/srikan-p/EE3900/tree/main/GATE_Assignment2/codes

Download all latex codes from

https://github.com/srikan-p/EE3900/tree/main/GATE_Assignment2

PROBLEM

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

- (A) $\frac{1}{5}e^{-j\frac{6\pi f}{5}}X\left(\frac{f}{5}\right)$
- (B) $\frac{1}{5}e^{j\frac{6\pi f}{5}}X\left(\frac{f}{5}\right)$
- (C) $\frac{1}{5}e^{j6\pi f}X\left(\frac{f}{5}\right)$
- (D) $\frac{1}{5}e^{j6\pi f}X\left(\frac{f}{5}\right)$

SOLUTION

By the time scaling property of Fourier transform,

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

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

By the time shifting property of Fourier transform,

$$x(t - t_0) \xrightarrow{\mathcal{F}} e^{-j2\pi f t_0}X(f) \quad (0.0.3)$$

$$x\left(5\left(t - \frac{3}{5}\right)\right) \xrightarrow{\mathcal{F}} \frac{1}{5}e^{-j\frac{6\pi f}{5}}X\left(\frac{f}{5}\right) \quad (0.0.4)$$

Let $x(t) = \text{rect}(t)$ and $\text{sinc}(t) = \frac{\sin(t)}{t}$

$$X(f) = \text{sinc}(f) \quad (0.0.5)$$

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

$$\frac{1}{5}e^{-j\frac{6\pi f}{5}}X\left(\frac{f}{5}\right) = \frac{1}{5}e^{-j\frac{6\pi f}{5}}\text{sinc}\left(\frac{f}{5}\right) \quad (0.0.6)$$

The correct option is (A).

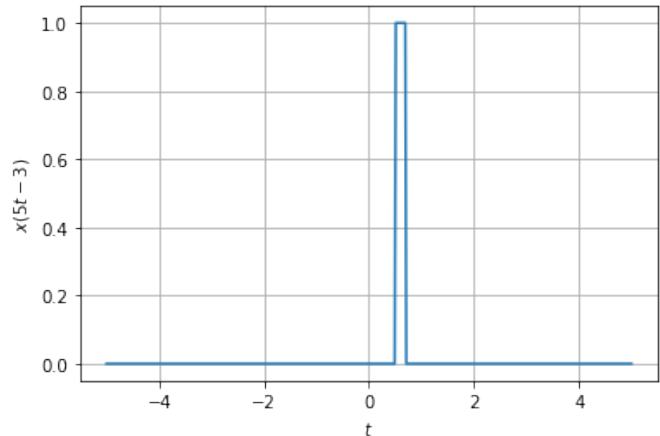


Fig. 4: Plot of $\text{rect}(5t-3)$

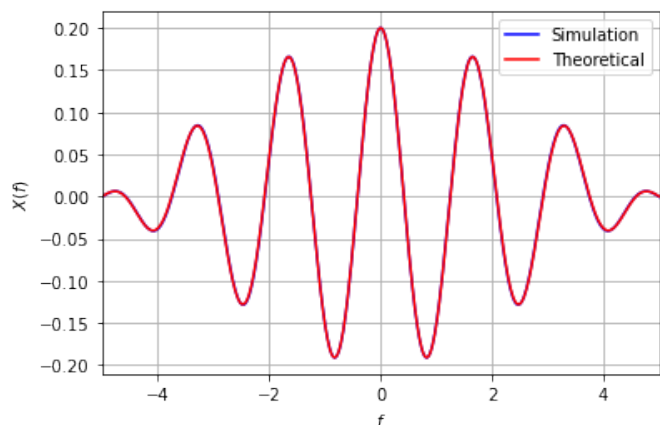


Fig. 4: Fourier transform Simulation v/s Theoretical