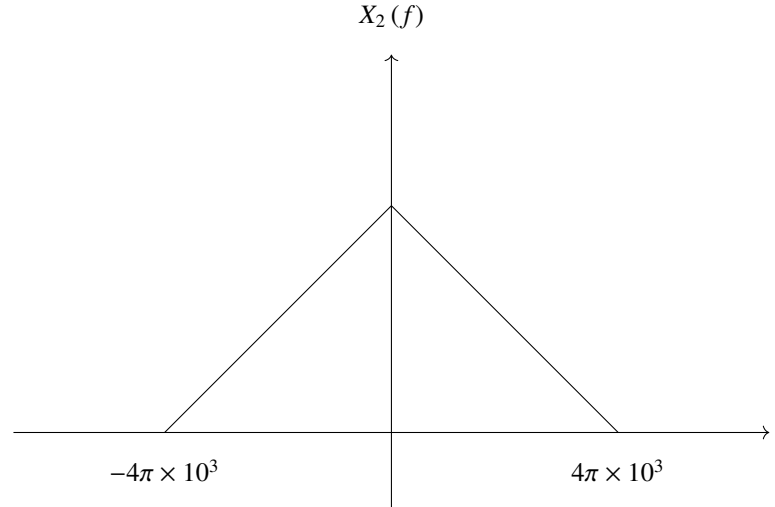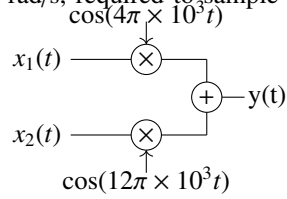# GATE 2023 - EC 50

EE23BTECH11220 - R.V.S.S Varun

QUESTION

Let $x_1(t)$ and $x_2(t)$ be two band-limited signals having bandwidth B = $4\pi \times 10^3$ rad/s each. In the figure below, the Nyquist sampling frequency, in rad/s, required to sample y(t), is

$$\cos(4\pi \times 10^3 t)$$

$x_1(t) \longrightarrow \otimes$

$\oplus \longrightarrow y(t)$

$x_2(t) \longrightarrow \otimes$

$$\cos(12\pi \times 10^3 t)$$

(a) $20\pi \times 10^3$
(b) $40\pi \times 10^3$
(c) $8\pi \times 10^3$
(d) $32\pi \times 10^3$

(GATE EC 50)

SOLUTION

Symbol	Description
Y(f)	y(t) in frequency domain
ω_m	Maximum frequency of Y(f)
ω_s	Nyquist sampling rate

TABLE 0

TABLE OF PARAMETERS

$x_1(t)$ and $x_2(t)$ in frequency domain ,

$X_1(f)$

$-4\pi \times 10^3$ $4\pi \times 10^3$

$X_2(f)$

$-4\pi \times 10^3$ $4\pi \times 10^3$

From figure ,

$$y(t) = x_1(t) * cos\left(4\pi \times 10^3 t\right) + x_2(t) * cos\left(12\pi \times 10^3 t\right) \tag{1}$$

$$Y(f) = X_1(f)\pi[\delta\left(2\pi f - 4\pi \times 10^3\right) + \delta\left(2\pi f + 4\pi \times 10^3\right)]+ \tag{2}$$

$$X_2(f)\pi[\delta\left(2\pi f - 12\pi \times 10^3\right) + \delta\left(2\pi f + 12\pi \times 10^3\right)]$$

$Y(f)$

$-16\pi \times 10^3$ $-8\pi \times 10^3$ $8\pi \times 10^3$ $16\pi \times 10^3$
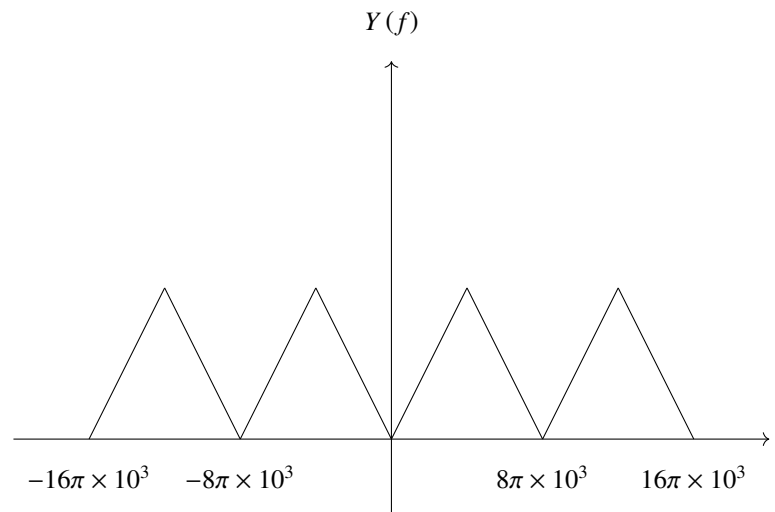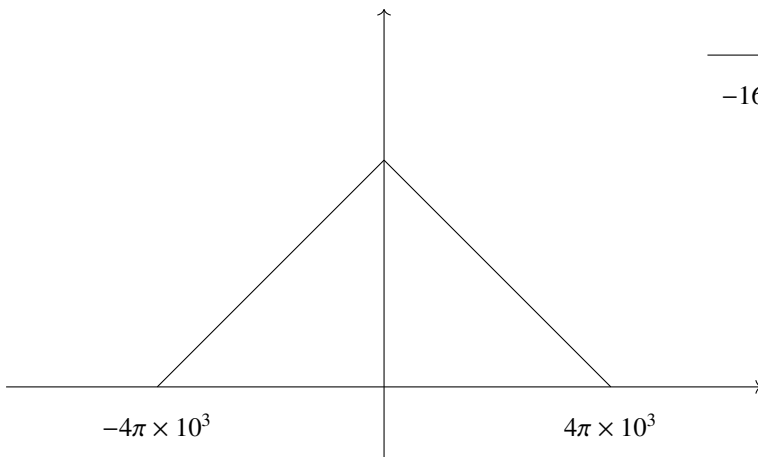
y(t) in frequency domain

$$\omega_m = 16\pi \times 10^3 \, rad/sec. \tag{3}$$

$$\omega_s = 2\omega_m = 32\pi \times 10^3 \, rad/sec. \tag{4}$$