

GATE Assignment 1

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Download all python codes from

<https://github.com/Adarsh541/EE3900/blob/main/Gate1/codes/Gate1.py>

Download latex-tikz codes from

<https://github.com/Adarsh541/EE3900/blob/main/Gate1/Gate1.tex>

1 PROBLEM(GATE 2021 EC Q4)

Consider a real-valued base-band signal $x(t)$, band limited to 10 kHz. The Nyquist rate for the signal $y(t) = x(t) x\left(1 + \frac{t}{2}\right)$ is

- 1) 15 kHz
- 2) 30 kHz
- 3) 60 kHz
- 4) 20 kHz

2 SOLUTION

Since $x(t)$ is a base-band signal bandwidth is equal to maximum frequency in the signal.

$$\text{bandwidth of } x(t) = 10\text{kHz} \quad (2.0.1)$$

$$\text{bandwidth of } x\left(1 + \frac{t}{2}\right) = \frac{10}{2}\text{kHz} \quad (2.0.2)$$

$$= 5\text{kHz} \quad (2.0.3)$$

$$\text{bandwidth of } y(t) = (10 + 5)\text{kHz} \quad (2.0.4)$$

$$= 15\text{kHz} \quad (2.0.5)$$

$$\text{Nyquist rate} = 2 \times \text{maximum frequency} \quad (2.0.6)$$

$$= 30\text{kHz} \quad (2.0.7)$$

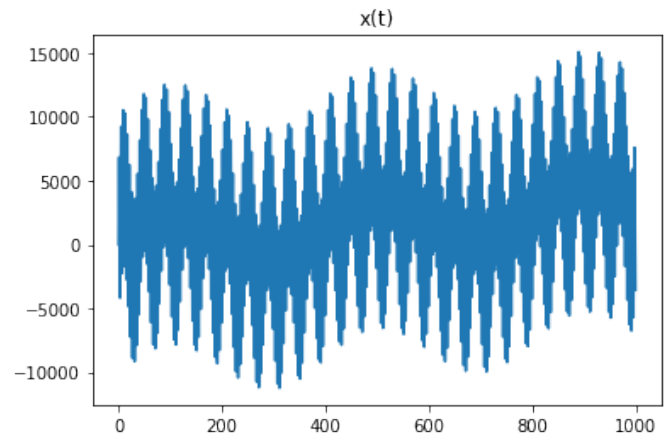


Fig. 4: A base-band signal with bandwidth 10 kHz

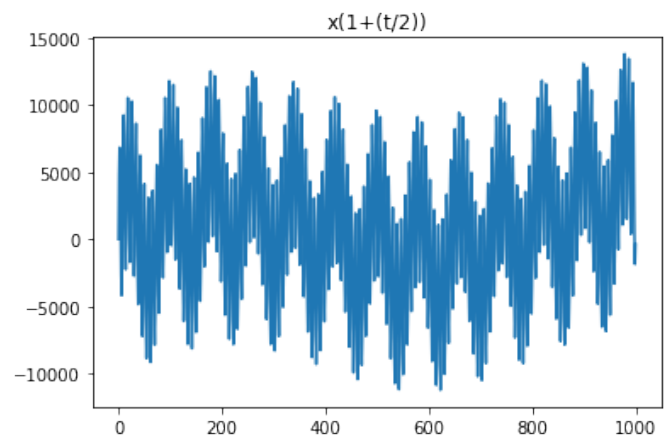


Fig. 4: $x\left(1 + \frac{t}{2}\right)$

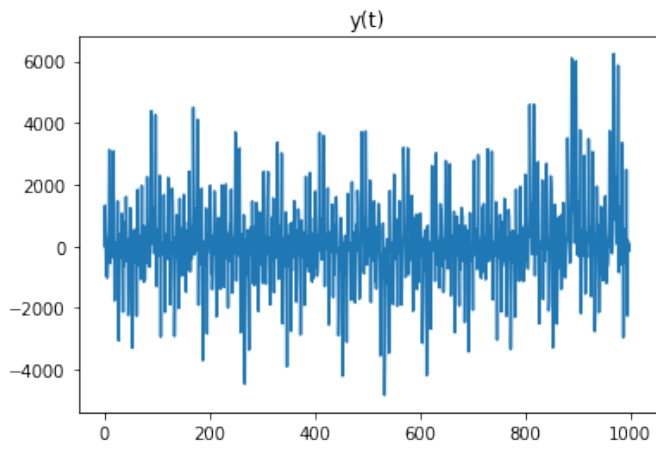


Fig. 4: $y(t)$

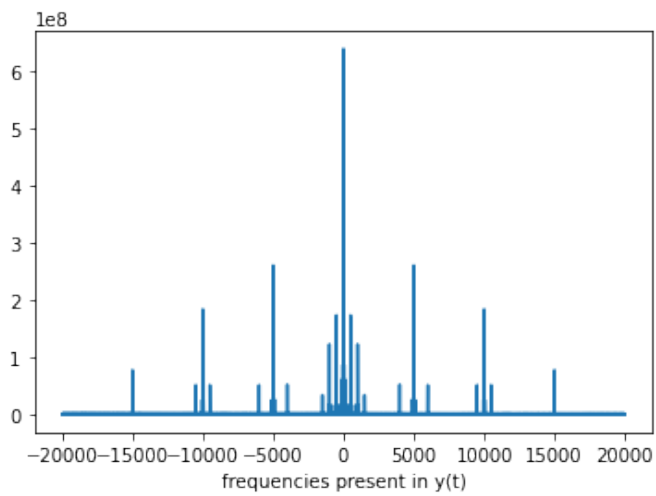


Fig. 4: Fourier transform of $y(t)$. The max frequency is 15 kHz