GATE Assignment 4

Adarsh Sai - AI20BTECH11001

Download all python codes from

https://github.com/Adarsh541/EE3900/blob/main/ Gate4/codes/Gate4.py

Download latex-tikz codes from

https://github.com/Adarsh541/EE3900/blob/main/ Gate4/Gate4.tex

1 Problem(GATE 2001 EC Q.2.19)

The Nyquist sampling interval, for the signal

$$x(t) = Sinc(700t) + Sinc(500t)$$
 (1.0.1)

is.

- 1) $\frac{1}{350}$ sec
- 2) $\frac{\pi}{350}$ sec
- 3) $\frac{1}{700}$ sec
- 4) $\frac{\pi}{175}$ sec

2 Solution

Lemma 2.1. Fourier transform of Sinc function

$$Sinc(at) \stackrel{\mathcal{F}}{\rightleftharpoons} \frac{1}{|a|} rect\left(\frac{f}{a}\right)$$
 (2.0.1)

Since Fourier Transform is linear, and using (2.0.1)

$$X(f) = \frac{1}{700} rect \left(\frac{f}{700}\right) + \frac{1}{500} rect \left(\frac{f}{500}\right)$$
 (2.0.2)

$$X(f) = 0 \text{ for } f > 350Hz$$
 (2.0.3)

Nyquist rate = $2 \times \max$ frequency

$$= 2 \times 350 Hz$$
 (2.0.5)

Nyquist sampling interval = $\frac{1}{\text{Nyquist rate}}$ (2.0.6)

$$= \frac{1}{700} sec (2.0.7)$$

Sampling rate(Hz)	Observations
fs = 1k	The signal is perfectly reconstructed. It is made up of frequencies $-350 < f < 350$.
fs = 2k	The signal is perfectly reconstructed. It is made up of frequencies $-350 < f < 350$.
fs = 500	150 < f < 350 are missing
fs = 600	250 < f < 350 are missing

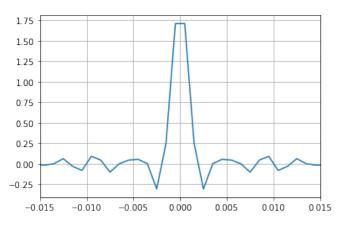


Fig. 4: Plot of x(t) sampled at 1kHz.

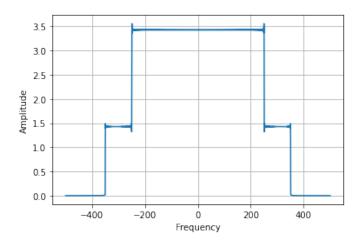


Fig. 4: DFT of x(t) sampled at 1kHz

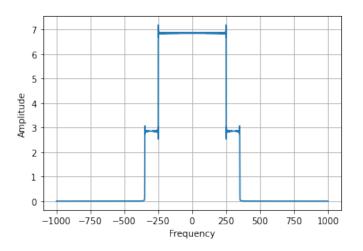


Fig. 4: DFT of x(t) sampled at 2kHz

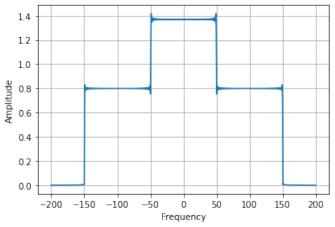


Fig. 4: DFT of x(t) sampled at 500Hz. f > 150 are not present.

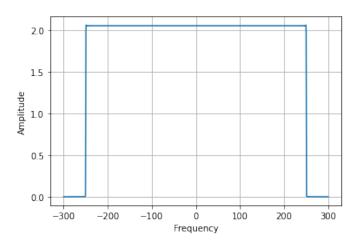


Fig. 4: DFT of x(t) sampled at 600Hz. f > 250 are not present.