Gate Assignment - 3

Chirag Mehta - AI20BTECH11006

Download all the python codes from

https://github.com/cmaspi/EE3900/tree/main/GateAssignment−3/Codes

latex-tikz codes from

https://github.com/cmaspi/EE3900/blob/main/GateAssignment−3/main.tex

1 Problem

(GATE EC 2002 q1.20) Consider a sampled signal $y(t) = 5 \times 10^{-6} x(t) \sum_{n=-\infty}^{\infty} \delta(t - nT_s)$ where $x(t) = 10\cos(8\pi \times 10^3 t)$ and $T_s = 100\mu$sec.When $y(t)$ is passed through an ideal low-pass filter with a cutoff frequency of 5KHz, the output of the filter is

1) $5 \times 10^{-6} \cos(8\pi \times 10^3 t)$
2) $5 \times 10^{-5} \cos(8\pi \times 10^3 t)$
3) $5 \times 10^{-1} \cos(8\pi \times 10^3 t)$
4) $10\cos(8\pi \times 10^3 t)$

2 Solution

The sampled signal is

$$y(t) = 5 \times 10^{-6} x(t) \sum_{n=-\infty}^{\infty} \delta(t - nT_s) \tag{2.0.1}$$

The sampling rate is

$$T_s = 100\mu\text{sec} \tag{2.0.2}$$

$$x(t) = 10\cos 8\pi \times 10^3 t \tag{2.0.3}$$

$$f_s = \frac{1}{T_s} = 10\text{KHz} \tag{2.0.4}$$

The frequency of $x(t)$ is clearly

$$f_m = 4\text{KHz} \tag{2.0.5}$$

Here, $f_s > 2f_m$ which satisfies the nyquist condition and thus information won't be lost in this sampling Also,

$$f_c > f_m \tag{2.0.6}$$

where f_c is the cut-off frequency of the low pass filter. Hence, the original signal can be recovered in frequency domain after passing through low pass filter. The output of the filter is given by

$$= 5 \times 10^{-6} \times 10\cos(8\pi \times 10^3 t) \tag{2.0.7}$$

$$= 5 \times 10^{-5} \times 10\cos(8\pi \times 10^3 t) \tag{2.0.8}$$

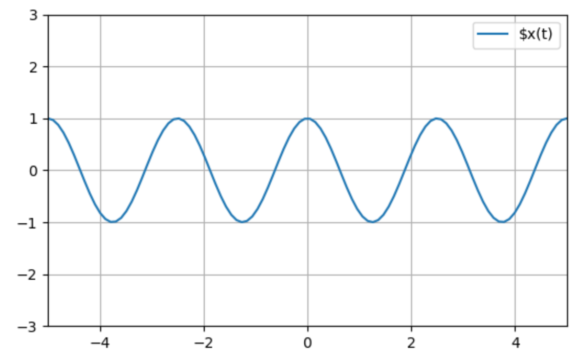

Fig. 4: Plot of xn