

# Gate Assignment - 3

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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>

in frequency domain after passing through low pass filter. The output of the filter is given by

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

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

## 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  $T_s = 100 \mu\text{sec}$ . 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

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

The sampling rate is

$$T_s = 100 \mu\text{sec} \quad (2.0.2)$$

$$x(t) = 10 \cos 8\pi \times 10^3 t \quad (2.0.3)$$

$$f_s = \frac{1}{T_s} = 10 \text{KHz} \quad (2.0.4)$$

The frequency of  $x(t)$  is clearly

$$f_m = 4 \text{KHz} \quad (2.0.5)$$

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

$$f_c > f_m \quad (2.0.6)$$

where  $f_c$  is the cut-off frequency of the low pass filter. Hence, the original signal can be recovered

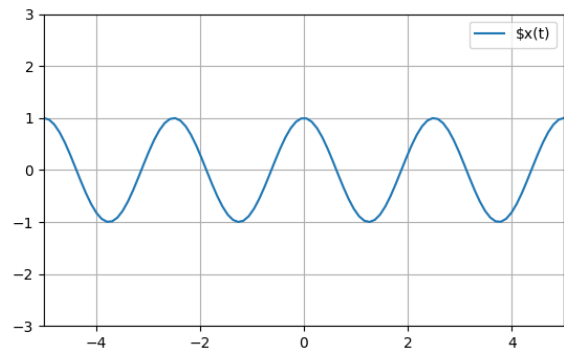


Fig. 4: Plot of  $x(t)$