

Q1: We need to process the audio signal  $x(t)$  with the magnitude frequency spectrum shown in Fig.1(a) using the setup in Fig.1(b). The frequencies of interest in  $x(t)$  are  $|f| < f_m = 10\text{KHz}$ , and No Aliasing is allowed through processing.

The available anti-Aliasing filter has the frequency response magnitude shown in Fig.1(c). Also, the C/D and D/C converters can go up to 50KHz sampling rate.

Specify the values of  $f_{s1}$ ,  $f_{s2}$  and  $\omega_N$ . Plot the magnitude frequency spectrum of the signals  $S_1, S_2, \dots, S_3$ . Pay special attention to the frequency axis.

Q2:

(a) Consider the system  $y(n) = e^{j\pi n} x(n)$ , with  $|x(n)| < \infty$  and  $\sum_{n=-\infty}^{\infty} |x(n)| < \infty$ . Is this system Linear? Time-Invariant? Stable?

(b) The system in (a) is used as shown in Fig.2(a). Sketch the magnitude frequency spectrum of  $r(n)$ ,  $y_1(n)$ ,  $p(n)$  and  $y_2(n)$  for the case of  $x(n)$  shown in Fig.2(b). Is  $y_1(n) = y_2(n)$ ? Explain your answer briefly.

