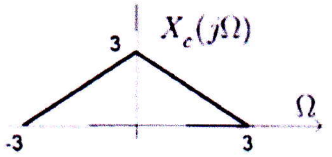
**Q [2]:** Mid1-291

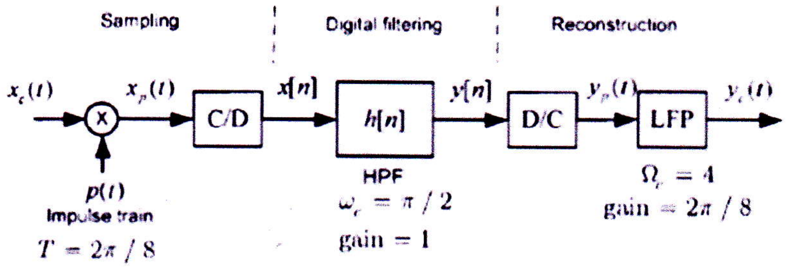
**(a)** Let $X_c(j\Omega)$ be the CTFT of the CT signal $x_c(t)$




- What is the maximum sampling period $T$ to avoid aliasing?
- What is the type and cutoff frequency of the filter required to reconstruct $x_c(t)$ from its samples without any distortion if the Nyquist sampling rate is used?

**(b)** In this part, assume that $x_c(t)$ is as given in (a) but we used a different sampling rate $T = 2\pi/8$. The CT signal $x_c(t)$ is converted to a DT signal $x[n]$, processed using a discrete-time HPF $h[n]$, then converted back to a CT signal $y_c(t)$ as shown below.

- Sketch $X_p(j\Omega)$, $X(e^{j\omega})$, $Y(e^{j\omega})$, $Y_p(j\Omega)$, and $Y_c(j\Omega)$




ⓐ Max $T \rightarrow$ Min $f_s$ (Nyquist rate)

$\Omega_s = 2\Omega_m = 2 \times 3 = 6$

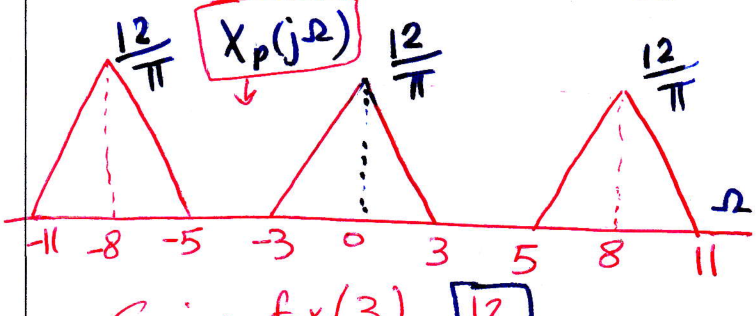
$f_s = \frac{6}{2\pi} = \frac{3}{\pi}$

$\rightarrow T = \frac{1}{f_s} = \boxed{\frac{\pi}{3}}$

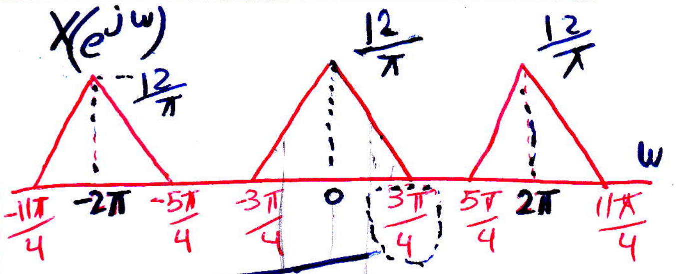
* LPF filter, $\Omega_c = 3$

ⓑ $f_s = \frac{4}{\pi} \rightarrow T = \frac{\pi}{4}$

$\rightarrow \Omega_s = 2\pi(f_s) = 8$ rad/s




Gain $\rightarrow f_s \times (3) = \boxed{\frac{12}{\pi}}$




$\omega = \Omega(T)$