3.)

$\alpha_p = 3dB$; $\omega_c = \omega_p = 2000\pi$ rad/s

$\alpha_s = 10 dB$; $\omega_s = 700\pi$ rad/s

$T = \frac{1}{f} = \frac{1}{5000} = 2\times10^{-4}$ sec.

Prewarping the digital frequencies we have

$$\Omega_p = \frac{2}{T}\tan\frac{\omega_p T}{2} = \frac{2}{2\times10^{-4}} \times \tan\left(\frac{2000\pi \times 2\times10^{-4}}{2}\right)$$

$$= 10^4 \tan(0.2\pi) = 7265 \text{ rad/s}$$

$$\Omega_s = \frac{2}{T}\tan\frac{\omega_s T}{2} = \frac{2}{2\times10^{-4}}\tan\left(\frac{700\pi\times2\times10^{-4}}{2}\right)$$

$$= 10^4 \times \tan(0.07\pi)$$

$$= 2235 \text{ rad/s.}$$

The order of the filter

$$N = \frac{\log\sqrt{\frac{10^{0.1\alpha_s}-1}{10^{0.1\alpha_p}-1}}}{\log\frac{\Omega_s}{\Omega_p}} = \frac{\log\sqrt{\frac{10^1-1}{10^{0.3}-1}}}{\log\frac{7265}{2235}} = \frac{\log 3}{\log 3.25} = 0.932$$

$\therefore \underline{\underline{N = 1}}$

Scanned with CamScanner

$\Omega_c = 1\,rad/s \Rightarrow H(S) = \frac{1}{1+S}$

$\Omega_c = \Omega_p = 7265\,rad/s.$

$$\boxed{\begin{array}{l} S \longrightarrow \frac{\Omega_c}{s} \\ \text{ie.)}\; s \longrightarrow \frac{7265}{s} \end{array}}$$

The transfor function of high pass filter

$$H(S) = \frac{1}{S+1}\Bigg|_{s = \frac{7265}{S}}$$

Using ~~bilear~~ bilinear transformation

$$H(z) = H(S)\Big|_{S = \frac{2}{T}\left(\frac{1-z^{-1}}{1+z^{-1}}\right)}$$

$$= \frac{S}{S+7265}\Bigg|_{S = \frac{2}{2\times10^{-4}}\left(\frac{1-z^{-1}}{1+z^{-1}}\right)}$$

$$\boxed{H(z) = \frac{0.5792(1-z^{-1})}{1-0.1584z^{-1}}}$$