3) Given

$\alpha_p = 3dB$, $\omega_c = \omega_p = 2\pi * 1000$

$= 2000\pi$ r/s

$\alpha_s = 10dB$; $\omega_s = (2\pi)(350) = 700\pi$ r/s

$\therefore T = \frac{1}{f} = 2 \times 10^{-4}$ sec

now $\rightarrow \Omega_p = \frac{2}{T} \tan \omega_p \frac{T}{2} = 10^4 \tan(0.2\pi)$

$= 7265$ rad/sec

$\rightarrow \Omega_s = \frac{2}{T} \tan \omega_s \frac{T}{2} = \frac{2}{2 \times 10^{-4}} \tan\left(\frac{700\pi \times 2 \times 10^{-4}}{2}\right)$

$= 10^{-4} \tan(0.07\pi) = 2235$ rad/sec

now since, we must design highpass filter;

$\therefore$ order of filter

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

$$= \frac{\log 3}{\log 3.25} = 0.932 \quad (\text{calc})$$

$N = 0.932 \cong 1$

now 1st order Filter for

$\Omega_c = 1$ rad/sec

is

$$H(s) = \frac{1}{1+s}$$

now from qp

$$\Omega_c = \Omega_p = 7265 \text{ rad/sec}$$

$$s \rightarrow \frac{\Omega_c}{s}$$

ie $s \rightarrow (7265)/s$

Transfer Function for Highpass filter

$$H(s) = \frac{1}{s+1}\Big|_{s = 7265/s}$$

$$H(s) = \frac{1}{\frac{7265}{s} + 1} = \frac{s}{7265+s}$$

B

PTO

C

Use bilinear transformation

$$H(z) = H(s)$$

$$s = \frac{2}{T}\left(\frac{1+z^{-1}}{1+z^{-1}}\right)$$

$$\therefore H(z) = \frac{s}{s+7265} \quad ; \quad s = \frac{2}{2\times10^{-4}}\left(\frac{1-z^{-1}}{1+z^{-1}}\right)$$

$$= \frac{10000\left(\frac{1-z^{-1}}{1+z^{-1}}\right)}{10000\left(\frac{1-z^{-1}}{1+z^{-1}}\right)+7265}$$

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

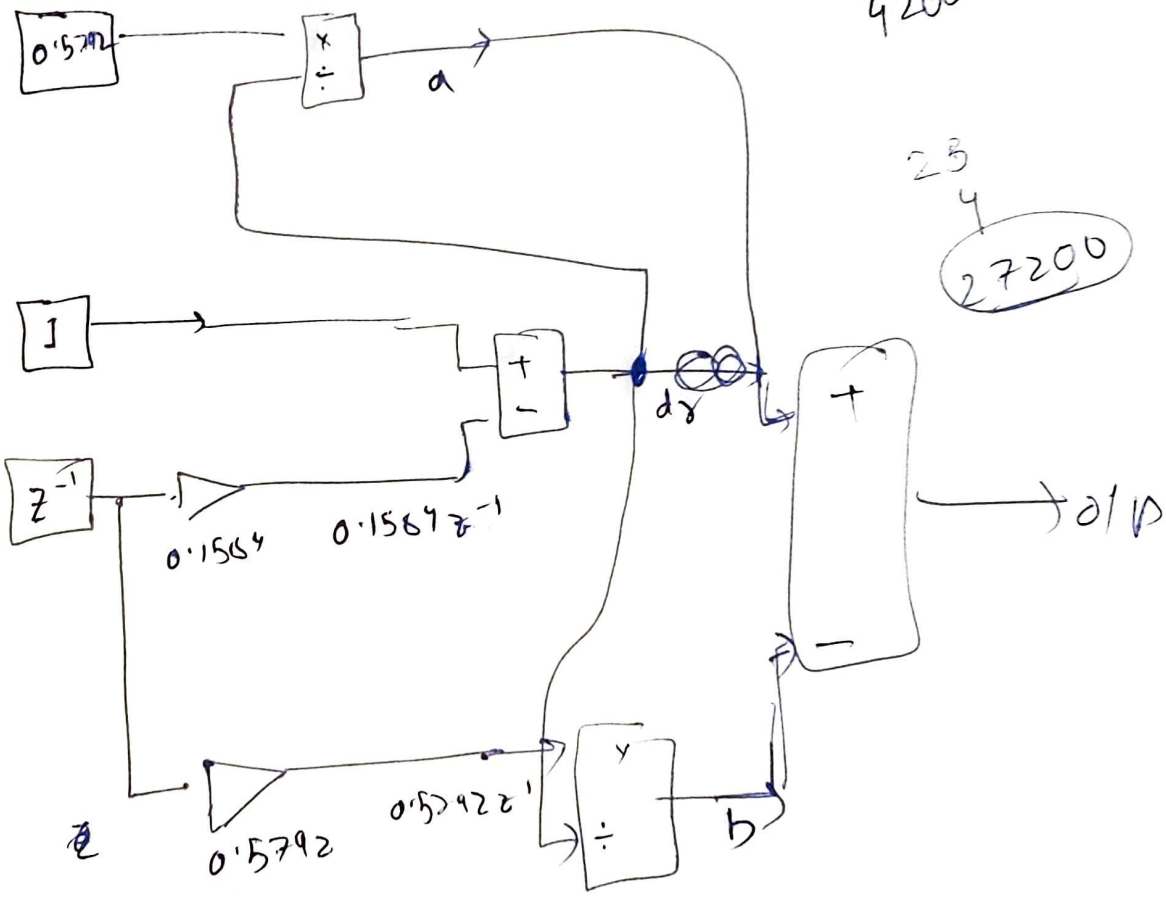
$$= \frac{0.5792 - 0.5792\,z^{-1}}{1-0.1584z^{-1}}$$

$$H(z) = \underbrace{\left[\frac{0.5792}{1-0.1584z^{-1}}\right]}_{a} - \underbrace{\left[\frac{0.5792\,z^{-1}}{1-0.1584z^{-1}}\right]}_{b}$$

$0.5792 - 0.5792 z^{-1}$ Rough

$$\left[\frac{0.5792}{1 - 0.1584 z^{-1}}\right] - \left[\frac{0.5792 z^{-1}}{1 - 0.1584 z^{-1}}\right]$$

dr



4200 +

23

4

27200

$$\frac{0.5792\left(1 - \frac{1}{z}\right)}{1 - \frac{0.584}{z}} \Rightarrow \frac{0.5792z - 1}{z - 0.584}$$