Problem - 3

$\omega_c = 2\pi F_c = 2\times\pi\times 1000 = 2000\pi$

$\omega_s = 2\pi F_s = 2\times\pi\times 350 = 700\pi$

$T = \frac{1}{f} = \frac{1}{5000.} = 0.2\text{ms}$

$\Omega_p = \frac{2}{T}\tan\frac{\omega_p T}{2} = \frac{2}{0.2\text{m}}\tan\frac{(2000\pi\times 0.2\times 10^{-3})}{2}$

$\Omega_s = \frac{2}{T}\tan\frac{\omega_s T}{2} = \frac{2}{0.2\text{m}}\tan\left(\frac{700\pi\times 0.2\text{m}}{2}\right) = 2235.3\text{ rad/sec}$

$= 7265.4\text{ rad/sec}$

$N = \frac{\log\sqrt{\frac{10^{0.1\alpha_s}-1}{10^{0.1\alpha_p}-1}}}{\log\frac{\Omega_s}{\Omega_p}} = \frac{\log\sqrt{\frac{10^{0.1(10)}-1}{10^{0.1(3)}-1}}}{\frac{\log(7265.4)}{\log(2235.3)}} = \frac{0.4471212}{0.5118836} =$

0.93208979

$N \approx 1$ order

$\Omega_c = 1\text{ rad/sec}$ in $H(s) = \frac{1}{1+s}$

$\Omega_c = \Omega_p = 7265\text{ rad/sec}$ $\quad s \to \frac{\Omega_c}{s} \to \frac{7265}{s}$

High Pass) T.F of high pass $H(s) = \frac{1}{s+1}\Big|_{s=\frac{7265}{s}} = \frac{1}{\frac{7265}{s}+1}$

Bilinear transformation

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

$H(z) = \frac{s}{s+7265}\Big|_{s=\frac{2}{0.2\text{m}}\left(\frac{1-z^{-1}}{1+z^{-1}}\right)}$

$= \frac{10^4\left(\frac{1-z^{-1}}{1+z^{-1}}\right)}{10^4\left(\frac{1-z^{-1}}{1+z^{-1}}+1\right)+7265}$

$= \frac{10^4(1-z^{-1})}{10^4(1-z^{-1})+7265(1+z^{-1})}$

$= \frac{10^4(1-z^{-1})}{10^4-10^4z^{-1}+7265+7265z^{-1}}$

$= \frac{10^4(1-z^{-1})}{17265-27352^{-1}}$

$= \frac{10^4(1-z^{-1})}{17265(1-0.1584129z^{-1})}$

$= \frac{0.5792065(1-z^{-1})}{1-0.1584129z^{-1}}$