Problem 3

$f_c = 1000$ Hz $w_c = 2000$ rad/s

$f_{st} = 350$ Hz $w_{st} = 700$ rad/s

$f_s = 5000$ Hz

$$T_s = \frac{1}{f_s} = 2 \times 10^{-4} \, s$$

Prewarping $\Omega_c = \frac{2}{T_s} \tan \frac{w_c T_s}{2}$

$= \cancel{7065 \text{ rad/s}}$ 7265 rad/s

$$\Omega_{st} = \frac{2}{T_s} \tan \frac{w_{st} T_s}{2} = 2235 \text{ rad/s}$$

Order $N = 1$

$$H(s) = \frac{1}{s+1} \bigg|_{s = \frac{7265}{s}} \quad \text{For HPF with order 1}$$

$$= \frac{s}{s+7265}$$

$$H(z) = H(s) \bigg|_{s = \frac{2}{T_s}\left(\frac{1-z^{-1}}{1+z^{-1}}\right)}$$

$$= \frac{s}{s+7265} \bigg|_{s = \frac{2}{T_s}\left(\frac{1-z^{-1}}{1+z^{-1}}\right)}$$

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

$$= \dfrac{0.5792\left(1-z^{-1}\right)}{1-0.1584\,z^{-1}}$$

$$Y(z) - 0.1584\,z^{-1}Y(z) + 0.5792\,X(z) - 0.5792\,z^{-1}\,X(z)$$