## Problem 8.2

a) $$\frac{G_\infty}{\left(1+\frac{\omega_0}{s}\right)} \quad \text{with} \quad \omega_0 = 2\pi f_0 \quad \text{— or} \quad \frac{G_\infty\left(\frac{s}{\omega_0}\right)}{\left(1+\frac{s}{\omega_0}\right)}$$

b) $$G_\infty \frac{\left(1+\frac{\omega_2}{Q_2 s}+\left(\frac{\omega_2}{s}\right)^2\right)}{\left(1+\frac{\omega_1}{Q_1 s}+\left(\frac{\omega_1}{s}\right)^2\right)} = G_\infty\left(\frac{\omega_2}{\omega_1}\right)^2 \frac{\left(1+\frac{s}{Q_2\omega_2}+\left(\frac{s}{\omega_2}\right)^2\right)}{\left(1+\frac{s}{Q_1\omega_1}+\left(\frac{s}{\omega_1}\right)^2\right)}$$

c) $$G_\infty \frac{\left(1+\frac{\omega_3}{Q_3 s}+\left(\frac{\omega_3}{s}\right)^2\right)}{\left(1+\frac{\omega_2}{s}\right)\left(1+\frac{\omega_1}{s}\right)} = G_\infty \frac{\omega_1\omega_2}{\omega_3^2} \frac{\left(1+\frac{s}{Q\omega_3}+\left(\frac{s}{\omega_3}\right)^2\right)}{\left(1+\frac{s}{\omega_1}\right)\left(1+\frac{s}{\omega_2}\right)}$$

## Problem 8.3

In the results of Problem 8.2, discard smallest terms in sums, let $s \to j\omega$ and take magnitude

a) $$\frac{G_\infty}{\left(\cancel{1}+\frac{\omega_0}{s}\right)} \cong G_\infty \frac{s}{\omega_0}. \quad \text{So for } \omega \ll \omega_0, \ \|G\| \to G_\infty \frac{\omega}{\omega_0}$$

because $\frac{\omega_0}{\omega} \gg 1$ for $\omega \ll \omega_0$

b) $$G_\infty \frac{\cancel{1}+\cancel{\frac{\omega_2}{Q_2 s}}+\left(\frac{\omega_2}{s}\right)^2}{\cancel{1}+\cancel{\frac{\omega_1}{Q_1 s}}+\left(\frac{\omega_1}{s}\right)^2} \cong G_\infty \frac{\left(\frac{\omega_2^2}{s^2}\right)}{\left(\frac{\omega_1^2}{s^2}\right)} = G_\infty \frac{\omega_2^2}{\omega_1^2}$$

c) $$G_\infty \frac{\cancel{1}+\cancel{\frac{\omega_3}{Q_3 s}}+\left(\frac{\omega_3}{s}\right)^2}{\left(\cancel{1}+\frac{\omega_2}{s}\right)\left(\cancel{1}+\frac{\omega_1}{s}\right)} \cong G_\infty \frac{\left(\frac{\omega_3^2}{s^2}\right)}{\left(\frac{\omega_2}{s}\right)\left(\frac{\omega_1}{s}\right)} = G_\infty \frac{\omega_3^2}{\omega_1\omega_2}$$