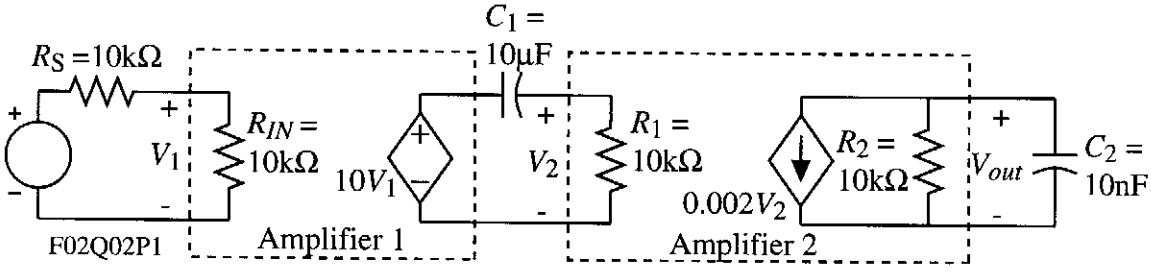
QUIZ NO. 2 - SOLUTION

(Average = 5.6/10)

a.) Find the transfer function, $V_{out}(s)/V_S(s)$, of the circuit shown and identify the location of the poles and zeros. What is the gain in the region where the transfer function is independent of frequency?



$$\frac{V_{out}(s)}{V_S(s)} = \left(\frac{V_{out}}{V_2}\right)\left(\frac{V_2}{V_1}\right)\left(\frac{V_1}{V_{in}}\right) = \left(\frac{-G(R_2/sC_2)}{R_2+1/sC_2}\right)\left(\frac{10R_1}{R_1+1/sC_1}\right)\left(\frac{R_{IN}}{R_S+R_{IN}}\right)$$

where $G = 0.002$ A/V. Rearranging gives,

$$\frac{V_{out}(s)}{V_S(s)} = \left(\frac{R_{IN}}{R_S+R_{IN}}\right)\left(\frac{10sR_1C_1}{sR_1C_1+1}\right)\left(\frac{-GR_2}{sR_2C_2+1}\right) = \left(\frac{10(-20)}{2}\right)\left(\frac{\frac{s}{10}}{\frac{s}{10}+1}\right)\left(\frac{1}{\frac{s}{10^4}+1}\right)$$

Poles are at -10 rads/sec. and -10^4 rads/sec. and the zeros are at 0 and ∞.

The gain in the frequency independent range (midband) is -100V/V.

b.) Sketch the asymptotic (straight-line) plot for the magnitude and phase of transfer function shown. Use the same plot for phase shift. Label the phase shift on the right side of the plot.

$$A(s) = \frac{-10s}{(s+1)(s+100)} \quad \rightarrow A(j\omega) = \left(\frac{-10}{100}\right)\left(\frac{\frac{j\omega}{1}}{\left(1+\frac{j\omega}{1}\right)\left(1+\frac{j\omega}{100}\right)}\right)$$

The asymptotic plot of the magnitude and phase of the above transfer function is shown: