

EE4086 Quiz 2

August 4, 1999

Professor Leach

Name _____

Instructions. Print your name in the space above and at the top of all other pages in your quiz. Do not write in the upper left hand corner of any page where you will staple the quiz.

1. Figure P1 shows an inverting integrator. The op amp has an open-loop transfer function that can be approximated by

$$\frac{V_o}{V_+ - V_-} = \frac{\omega_x}{s}$$

where ω_x is the gain bandwidth product.

- (a) Solve for the closed-loop transfer function, i.e. V_o/V_i .
 - (b) Sketch the asymptotic and actual Bode magnitude plots. Label the break frequency, the asymptotic gain at the break frequency, and the actual gain at the break frequency.
2. Figure P2 shows an inverting amplifier. It is given that $R_1 = 1 \text{ k}\Omega$ and $R_F = 50 \text{ k}\Omega$.
- (a) Solve for v_O if the op amp has an input offset voltage $V_{IO} = 5 \text{ mV}$.
 - (b) Solve for v_O if the op amp has an input bias current $I_{IB} = 1 \text{ }\mu\text{A}$.
3. A second-order Butterworth low-pass filter has the magnitude squared transfer function

$$\left| \frac{V_o}{V_i} \right|^2 = \frac{K^2}{1 + (\omega/\omega_c)^2}$$

where K is the dc gain and ω_c is the -3 dB cutoff frequency. In general, the transfer function of a second-order low-pass filter is given by

$$\frac{V_o}{V_i} = \frac{K}{(s/\omega_o)^2 + (1/Q)(s/\omega_o) + 1}$$

- (a) Solve for ω_o and Q such that the filter is Butterworth.
 - (b) Sketch the asymptotic and actual Bode magnitude plots, label the break frequency, the asymptotic gain on the zero-slope asymptote, and the actual gain at the break frequency.
4. Figure P4 shows the circuit of a second-order, infinite-gain, multi-feedback, low-pass filter.
- (a) Write the node equations for the circuit and solve for the voltage gain transfer function.
 - (b) Specify K , ω_o , and Q if the transfer function is put into the form

$$\frac{V_o}{V_i} = \frac{K}{(s/\omega_o)^2 + (1/Q)(s/\omega_o) + 1}$$