ELEC301 Problem Set #7

1. A feedback amplifier is designed using a gain of 10^4 for the basic amplifier and $\beta = 10^{-2}$. However, the basic amplifier actually has a gain of 7×10^3.

a) What percentage of the intended gain does the actual gain represent?

b) Derive an expression for $\partial A_f / \partial A$ in terms of A and β.

c) By deriving the transfer function with feedback, explain why, for an amplifier having a low pass, single time-constant, frequency response, for every 20 dB of gain sacrificed by the application of negative feedback the 3dB bandwidth is extended by a decade. (Assume the feedback is purely real, i.e., frequency independent).

2. Use feedback techniques to show that the circuit shown in figure1 has a gain of $-R_2/R_1$.

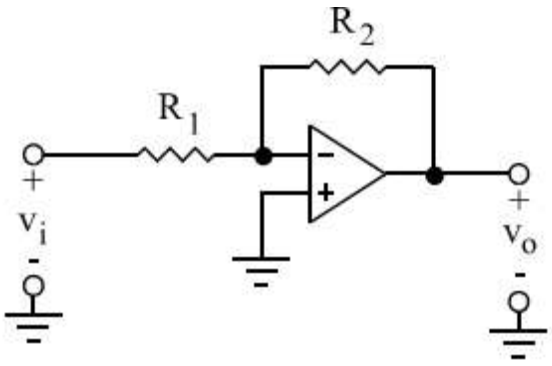

Figure 1.

3. The op amp shown in figure 2 has an open-loop gain of 10^5 and a bandwidth of 10Hz. Use feedback techniques to calculate the gain and bandwidth of the circuit shown in figure 2? What would the gain and bandwidth be if the open-loop gain of the op amp was 5×10^4 instead of 10^5?

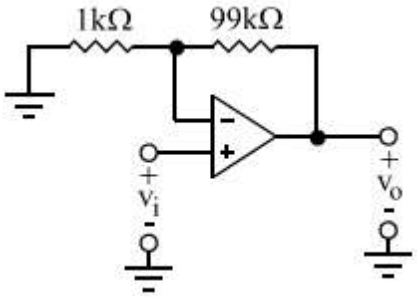

Figure 2.

4. For the circuit shown in figure 3 calculate A_M, Z_i, and Z_o, all at mid band.

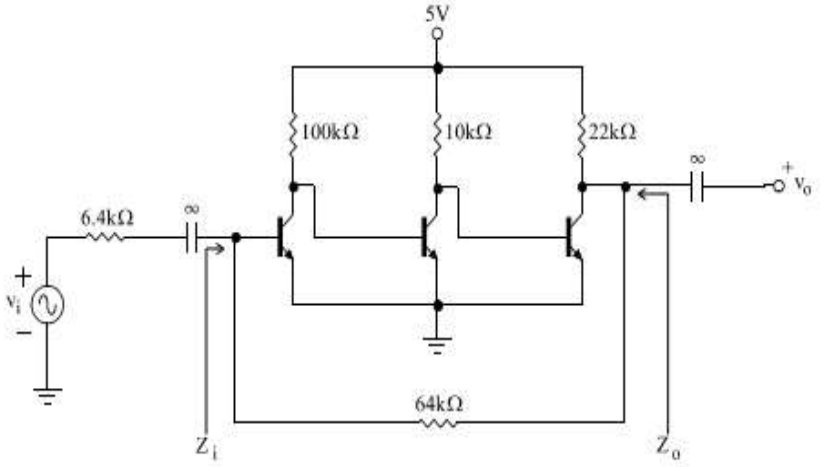

Figure 3.

5. Analyze the circuit shown in figure 4 using feedback techniques (the best topology is the series-series topology) with RE forming the feedback network and for the transistor having an ro = 50 kΩ to find the small-signal voltage gain of the amplifier, Av = vo/vs, Ri and Ro all at mid band.

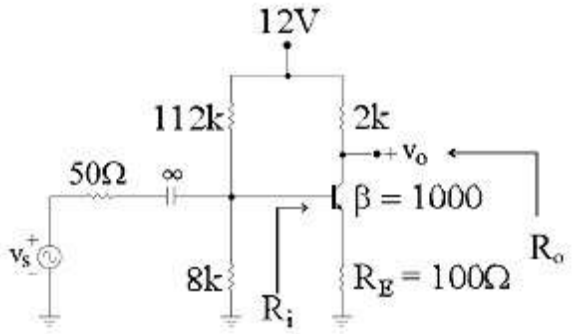

Figure 4.

6. Negative feedback is to be applied to an open-loop amplifier having the following transfer function:

$$T(s) = \frac{10^4}{\left(1+\frac{s}{10^6}\right)\left(1+\frac{s}{10^8}\right)^2}$$

a) Sketch the magnitude and phase plots for the open-loop amplifier.
b) What value of β will give a phase margin of 45°?
c) What is the corresponding gain margin in the above case?
d) What is β when the gain margin is zero?
e) What are the gain and phase margins when β equals 10^{-3}?

7. For the circuit shown in figure 5 use feedback techniques to find the mid band gain, $A_M = v_o/v_s$, the gain margin, G.M., the phase margin, P.M. = $\varphi_1 - \varphi_{180}$, the input resistance, R_i, of the amplifier as shown, and output resistance, R_o, of the amplifier as shown. Use the series-shunt feedback topology.

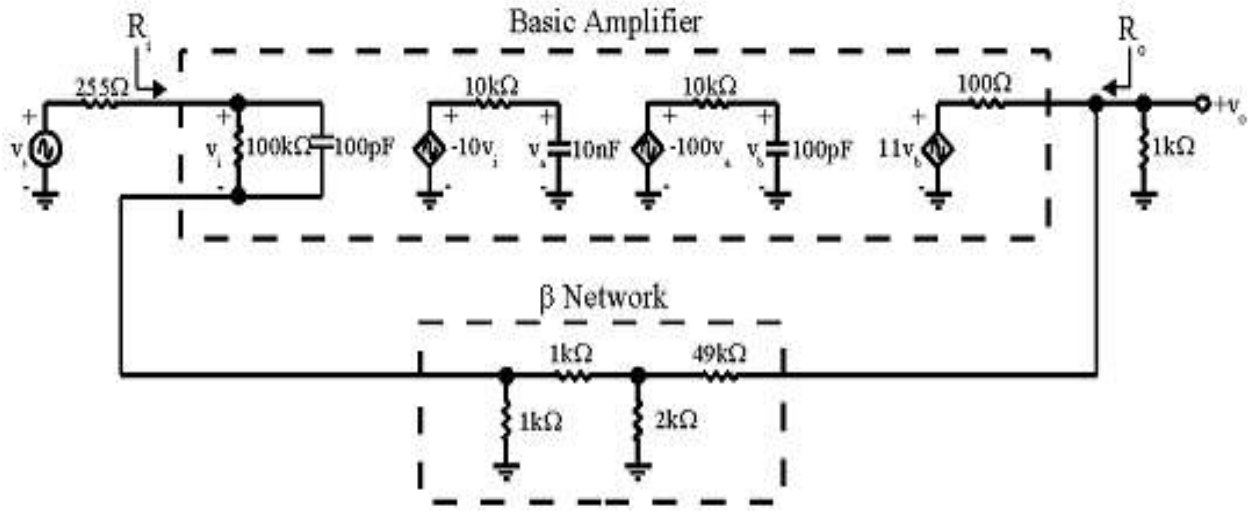

Figure 5.