Analog Circuits (EE3002/EE5310) : Problem Set 9

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In this problem set, we use the following symbol to denote a voltage-controlled current source with finite output resistance.

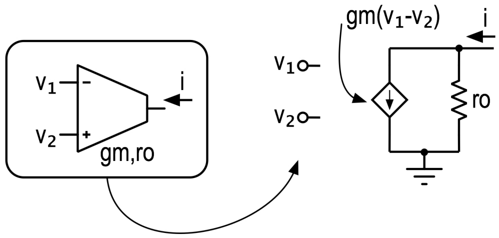

Figure 1: Symbol used for a voltage-controlled current source.

Problem 1

A loop gain function is of the form $\frac{A_o}{(1+\frac{s}{\omega_1})(1+\frac{s}{2\omega_1})(1+\frac{s}{6\omega_1})}$. Using the approach discussed in class, find the permissible range of A_o for the closed loop system to be stable.

Problem 2

The loop gain of a feedback amplifier is of the form

$$LG(s) = \frac{A_o f}{\left(1+\frac{s}{\omega_p}\right)^n} \tag{1}$$

where all terms have their usual meanings. Determine the largest magnitude of $A_o f$ that one could use before the closed loop system becomes unstable.

Problem 3

Fig. 2 shows the simplified schematic of a two-stage opamp. The opamp is configured to work as a unity-gain follower, driving a load, as shown in the lower part of the figure. Determine the value of the compensating capacitor C needed for the negative feedback loop to achieve a phase margin of 60 degrees. For this value of C, determine the 3-dB bandwidth of the unity-gain follower.

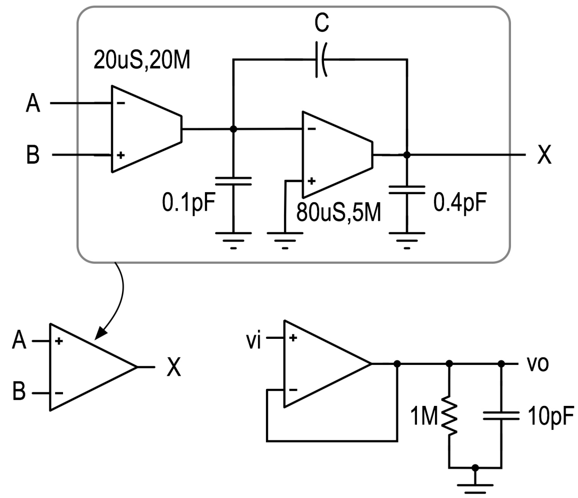

Figure 2: Circuit for problem 3.

With C being the one determined above, the 10 pF load is removed. What is the phase margin now?

Problem 4

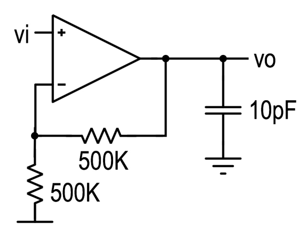

Figure 3: Circuit for problem 4.

The opamp of Problem 3, (with the C you determined there) is configured as a gain-of-two amplifier as shown in Fig. 3. What is the bandwidth of the amplifier? What is the phase margin?

Assume that C can be changed. What C will you use to achieve a 60 degree phase margin? What is the amplifier bandwidth now?