## PROBLEM SET \#9

Issued: Tuesday, Apr. $5^{\text {th }}, 2011$
Due: Tuesday, Apr. 12th, 2011, 5:00 p.m. in the EE 140 homework box in 240 Cory

1. An amplifier has a low frequency forward gain of 5,000 and its transfer function has 3 negative real poles with magnitudes at $300 \mathrm{kHz}, 2 \mathrm{MHz}$ and 25 MHz .
a) Suppose the 3 original amplifier poles remain fixed and a phase margin of $45^{\circ}$ is desired for a unity-gain feedback configuration. If compensation is to be achieved by introducing a dominant pole, calculate the dominant-pole frequency required. What is the resulting bandwidth of the circuit with the unity-gain feedback applied?
b) Repeat a) with a closed-loop gain of 20 dB and $45^{\circ}$ phase margin.
2. The opamp in the circuit of Fig. PS9.1 has an open-loop gain of 10,000 and a single-pole roll-off with cut-off frequency $\omega_{3 d B}=10 \mathrm{rad} / \mathrm{s}$.
a) Sketch magnitude and phase Bode plots of the loop transmission.
b) Find the frequency at which the loop gain $=1$, and find the corresponding phase margin.
c) Find the closed-loop transfer function, including its zeros and poles. Sketch a pole-zero plot. Sketch magnitude and phase Bode plots of the closed-loop circuit and label the important parameters on your sketch, e.g. low frequency gain, pole frequency, overshoot height.


Fig. PS9.1

