E4215: Analog Filter Synthesis and Design: HW2

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For the opamps, use the appropriate model based on the parameters provided. i.e. if nothing is given, assume an ideal opamp with infinite gain; if the unity gain frequency is given, use the integrator model; if the dc gain and the unity gain frequency are given, use the first order model etc. This holds for all future assignments.

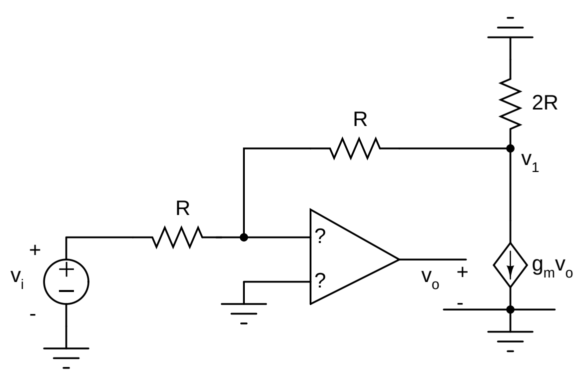


Figure 1:

1. (2 pts.) [Fig. 1, $g_m = 4/R$] Assign the correct signs to the opamp such that it has negative feedback at dc.

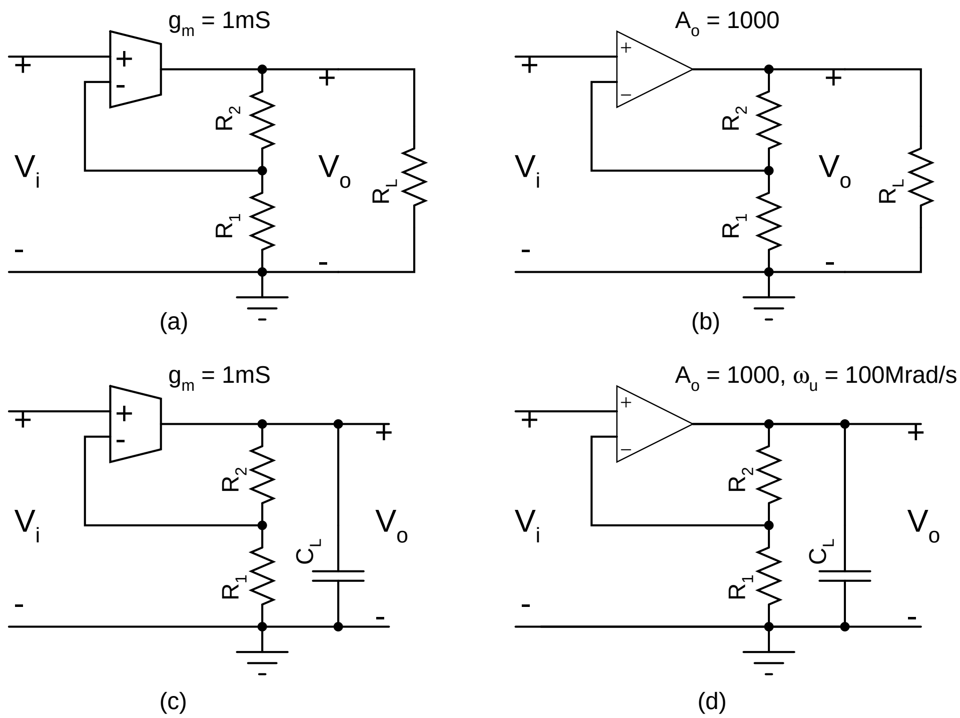
2. (2 pts.) [Fig. 1, $g_m = 4/R$] Assuming that the opamp has a transfer function $A(s) = \omega_u/s$, determine the transfer functions $V_o(s)/V_i(s)$, $V_1(s)/V_i(s)$.

3. (4 pts.) [Fig. 1, $g_m = 4/R$] Determine the loop gain $T(s)$ around this feedback loop. Assuming that the opamp has a dc gain $A_o = 100$ and a unity gain frequency $\omega_u = 1\,\text{Grad/s}$[1], draw the Bode plot (magnitude and phase) of loop gain $T(s)$ and op amp gain $A(s)$.

4. (6 pts.) Assume $g_m = 1\,\text{mS}, R_1 = 900\,\text{k}\Omega, R_2 = 100\,\text{k}\Omega, R_L = \infty, A_o = 1000$. For the circuits in Fig. 2(a) and Fig. 2(b), evaluate the gain V_o/V_i and the feedback loop gain T. Repeat, assuming $R_L = 1\,\text{M}\Omega$.

5. (6 pts.) Assume $g_m = 1\,\text{mS}, R_1 = 900\,\text{k}\Omega, R_2 = 100\,\text{k}\Omega, C_L = 10\,\text{pF}, A_o = 1000, \omega_u = 100\,\text{Mrad/s}$[2]. For the circuits in Fig. 2(c) and Fig. 2(d), evaluate the transfer function $V_o(s)/V_i(s)$ and the feedback loop gain T(s). Write the transfer functions in the standard first order form and compare the two results. Repeat, assuming $C_L = 20\,\text{pF}$.

[1] giga radians/second; giga=10^9
[2] mega radians/second



g_m = 1mS
A_o = 1000
V_i
V_o
R_1
R_2
R_L
(a)
(b)
g_m = 1mS
A_o = 1000, ω_u = 100Mrad/s
C_L
(c)
(d)

Figure 2: