1. (15%) The circuit shown in Figure 1 has parameters $V^+ = 10$ V, $V^- = -10$ V, $R_S = 0.5$ kΩ, $R_E = 4$ kΩ, and $R_C = 2$ kΩ. The transistor parameters are $\beta = 100$, $V_{BE}(\text{on}) = 0.7$ V, and $V_A = \infty$. (a) Determine the quiescent value (I_{CQ}) and small-signal parameters (g_m and r_π) of the transistor. (b) Determine the value of C_E such that the 3dB frequency related to the zero is 1 Hz. (c) Following (a) and (b), determine the 3dB frequency related to the pole. ↳ 上面的?

2. (12%) For the circuit is Figure 2, the transistor parameters are $K_n = 0.5$ mA/V^2, $V_{TN} = 2$ V, and $\lambda = 0$. Assume that $I_{DQ} = 1.2$ mA. (a) Determine the value of C_L such that the bandwidth is 5MHz for the circuit (5%). (b) determine the 3dB frequencies related to C_{C1} and C_{C2} respectively (5%). (c) What is the dominant lower 3dB frequency (2%)? 分別

↳ 哪個是 dominant

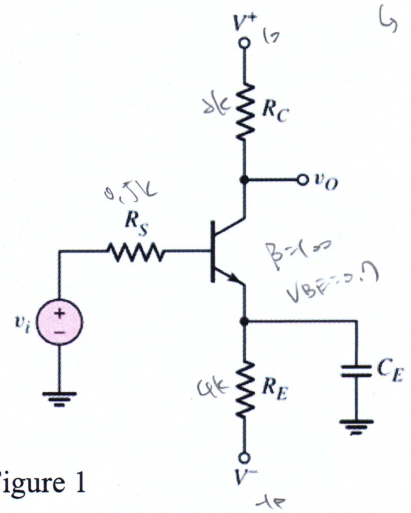

Figure 1

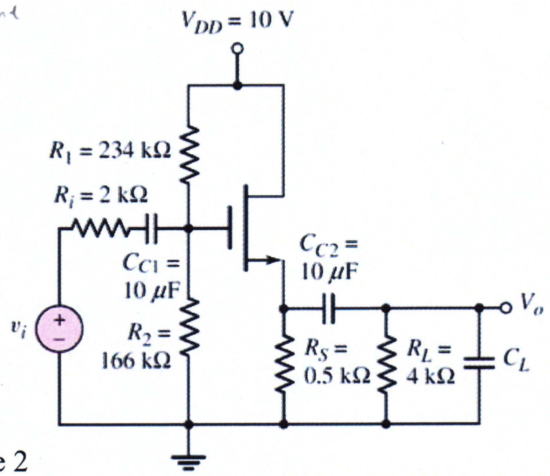

Figure 2

3. (20%) For the PMOS circuit shown in Figure 3, the transistor parameters are: $K_p = 1$ mA/V^2, $V_{TP} = -2$ V, $\lambda = 0$, $C_{gs} = 15$ pF, $C_{gd} = 3$ pF. Assume that $I_{DQ} = 3.12$ mA. (a) Find the midband voltage gain. (b) What is the equivalent Miller capacitance? (c) Determine the upper 3dB frequency.

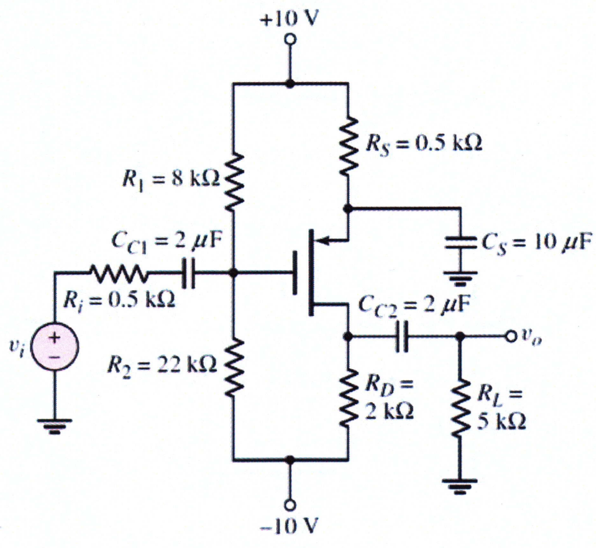

Figure 3

4. (12%) (a) Determine the transfer function $T(j\omega)$ correspond to the Bode plot of the magnitude shown in Figure 4. (b) If this transfer function belongs to an inverting amplifier, please plot the approximate phase plot of the transfer function.

5. (10%) The inverting op-amplifier shown in Figure 5 has parameters $R_1 = 25\ \text{k}\Omega$, $R_2 = 150\ \text{k}\Omega$, and open-loop gain $A_{od} = 1000$. The input voltage is from an ideal voltage source whose value is $v_I = 1\ \text{V}$. (a) Calculate the actual close-loop voltage gain. (b) What is the voltage at the inverting input terminal of the op-amp?

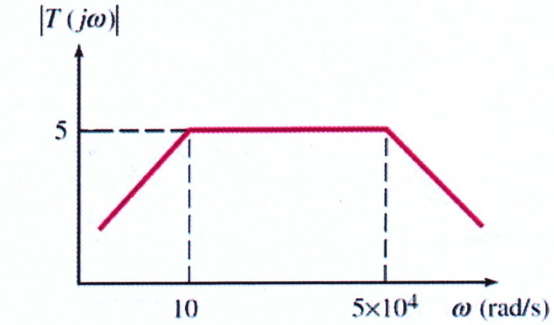

Figure 4

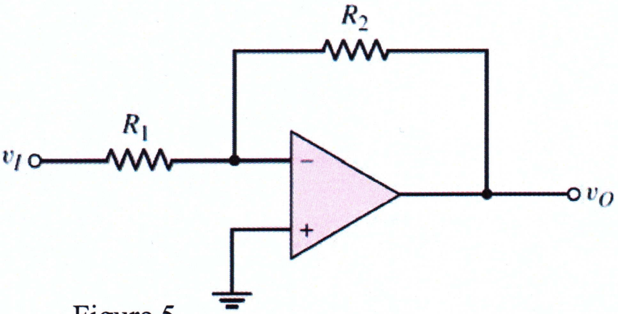

Figure 5

6. (15%) For the circuit shown in Figure 6, (a) derive the voltage transfer function $A_v = v_O/v_I$ as a function of frequency. (b) What is the voltage gain as the frequency becomes large? (c) At what frequency is the magnitude of the gain a factor of $\sqrt{2}$ less than the high-frequency gain?

7. (16%) For the instrumentation amplifier in Figure 7, the parameters are $R_4 = 90\ \text{k}\Omega$, $R_3 = 30\ \text{k}\Omega$, and $R_2 = 50\ \text{k}\Omega$. Resistance R_1 is a series combination of a fixed $2\ \text{k}\Omega$ resistor and a $98\ \text{k}\Omega$ potentiometer (6%). (a) Determine the range of the differential voltage gain. (b) If one of the resistor R_3, which is connected to the inverting terminal of A3, is $R_3' = 30\ \text{k}\Omega + 5\%$. Assume that $R_1 = 10\ \text{k}\Omega$ and determine the CMRR (10%).

$V_O = \frac{R_4}{R_3}(v_2 - v_1)$

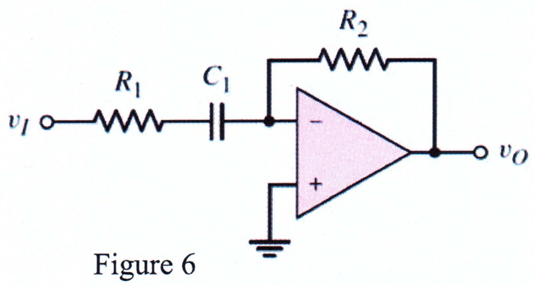

Figure 6

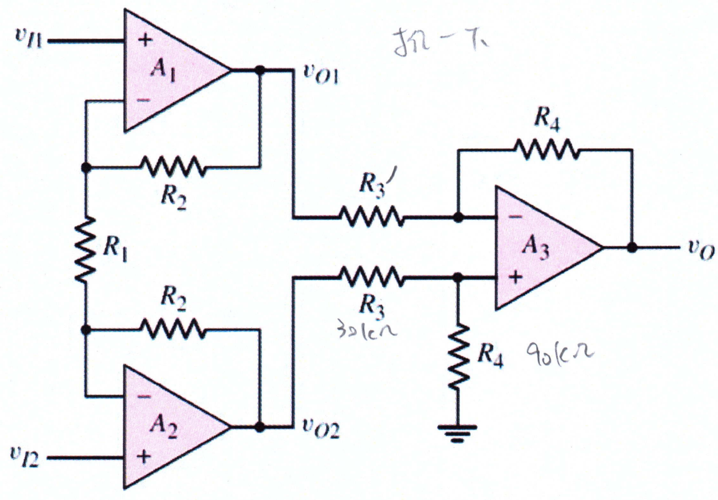

Figure 7