Electronics II, Exam-4, Spring 2023

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June 9, 2023, Prof. Dah-Chung Chang (E1-311)

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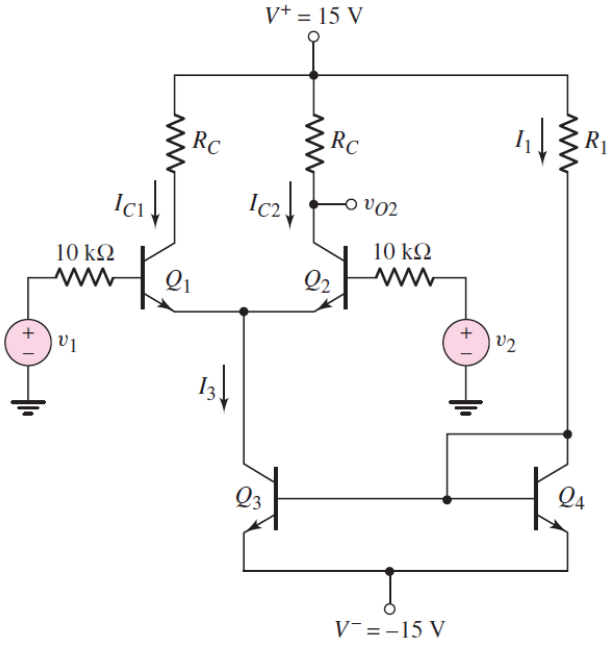
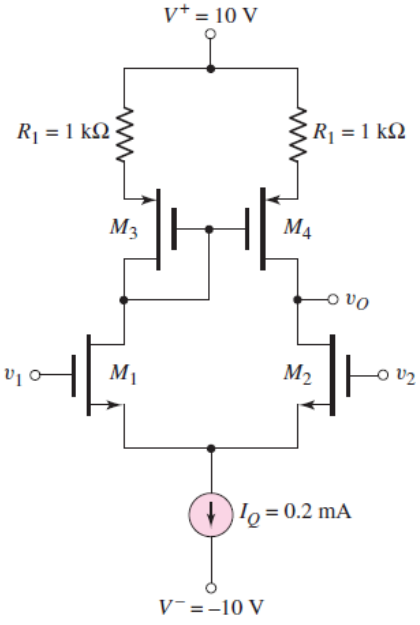
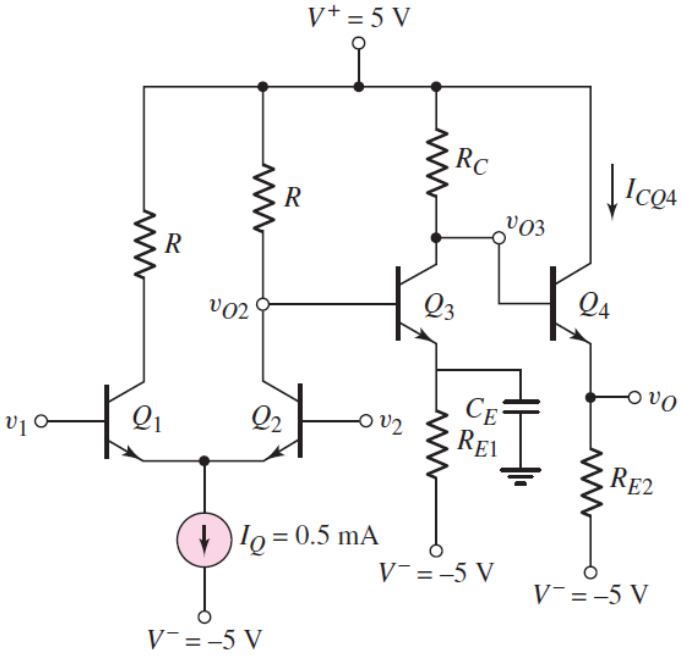
1. (25%) The transistor parameters are: β = 100, V_{BE} (on) = 0.7 V, the Early voltage $V_A = \infty$ for Q_1 and Q_2, and $V_A = 50$ V for Q_3 and Q_4.
   (a) Find the resistor values R_1 and R_C such that $I_3 = 0.4mA$ and $V_{CE1} = V_{CE2} = 10\text{V}$. (10%)
   (b) Find CMRR in dB for a one-sided output at v_{O2}. (15%)



2. (25%) The PMOS parameters are $K_p = 80\mu\text{A/V}^2, \lambda_p = 0.02\,\text{V}^{-1}, V_{TP} = -2\text{V}$. The NMOS parameters are $K_n = 80\mu\text{A/V}^2, \lambda_n = 0.015\,\text{V}^{-1}, V_{TN} = +2\text{V}$. Determine the open-circuit differential-mode voltage gain.



3. (25%) The transistor parameters are β = 120, V_{BE} (on) = 0.7 V, and $V_A = \infty$. Assume that $R = 20k\Omega$, $R_{E1} = R_C = 17.2k\Omega$, $R_{E2} = 2.5k\Omega$, and the output resistance of the current source is $200k\Omega$. Determine the differential-mode voltage gain $A_d = v_o / (v_1 - v_2)$. (Note: The base current for a transistor can be neglected and C_E acts as a short circuit in analyzing the small signal circuit.)



4. (25%) The circuit parameters are $V^+ = 3$ V, $V^- = -3$ V, and $I_Q = 0.4mA$. The NPN transistor parameters are $\beta = 180, V_{BE}(\text{on}) = 0.7\text{V}$, and $V_{AN} = 120\text{V}$, and the PNP transistor parameters are $\beta = 120, V_{BE}(\text{on}) = 0.7\text{V}$, and $V_{AP} = 80\text{V}$. Determine the one-sided differential-mode gain $A_{d2} = v_{O2} / v_d$.