Electronics II, Exam-4, Spring 2025

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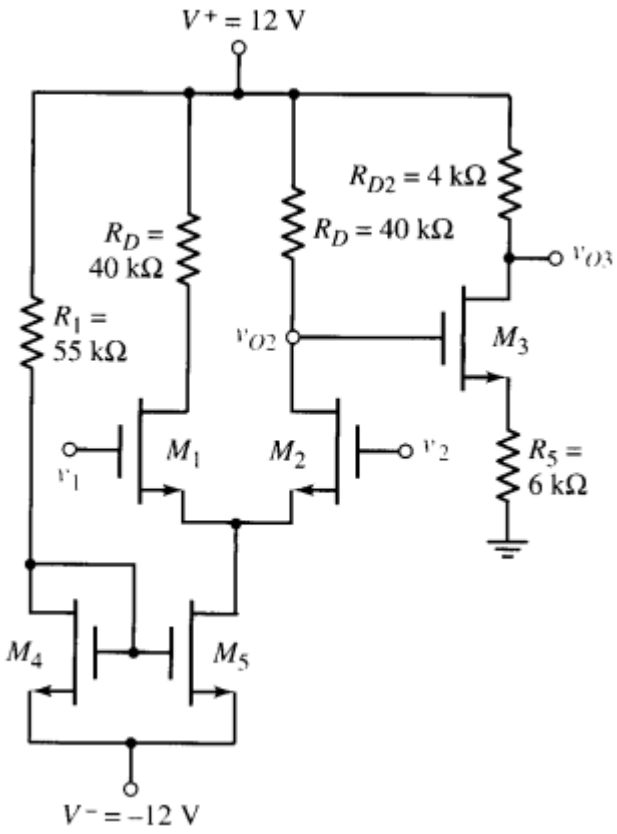
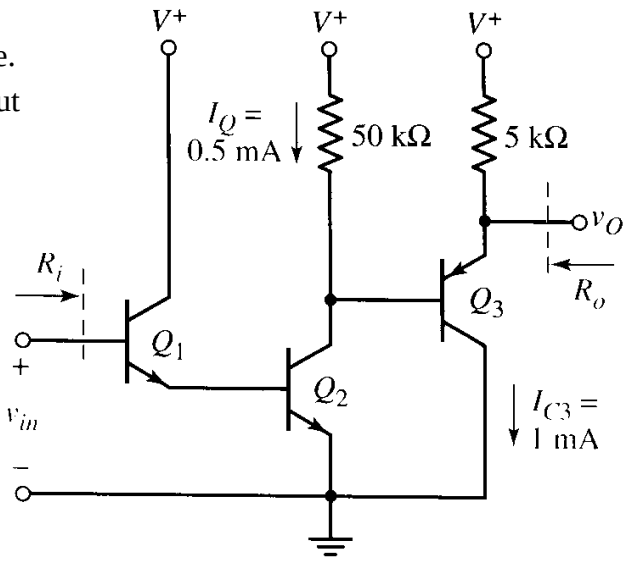
13th June, 2025, Prof. Dah-Chung Chang (E1-311)

Note: Exam time is 10:00AM-12:00PM. The calculator is allowed.

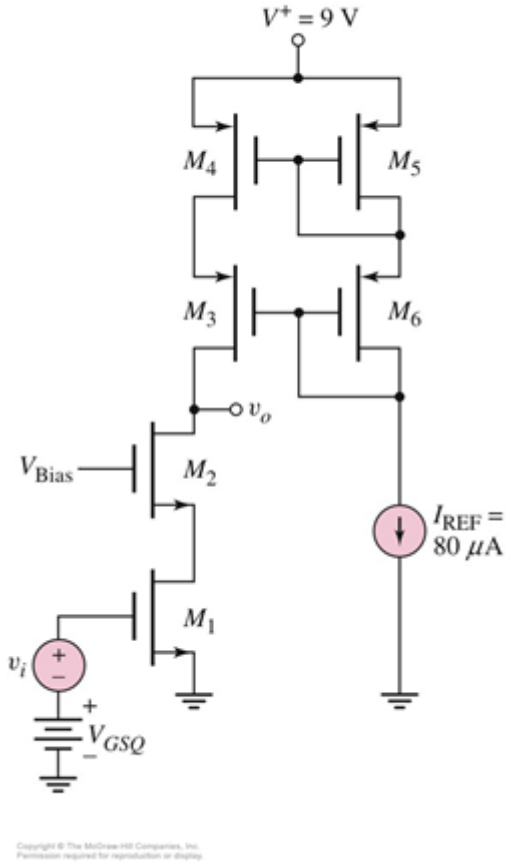
1. (30%) The transistor parameters are: $K_n = 0.2mA/V^2$, $V_{TN} = 2V$, and $\lambda = 0.02V^{-1}$.
   (a) Determine the differential-mode voltage gain $A_d = v_{o3}/v_d$ and the common-mode voltage gain $A_{cm} = v_{o3}/v_{cm}$. (20%)
   (b) Determine the output voltage v_{o3} if $v_1 = 2.15\sin \omega t$ V and $v_2 = 1.85\sin \omega t$ V. (10%)



2. (20%) The transistor parameters are $\beta = 100$ and $V_A = \infty$. The bias currents are indicated on the figure.
   (a) Determine the input resistance R_i and the output resistance R_o. (10%)
   (b) Determine the small-signal voltage gain $A_v = v_o/v_{in}$. (10%)



3. (20%) The transistor parameters are $V_{TN} = 0.8V, V_{TP} = -0.8V, \frac{1}{2}k_n' = 50\mu A/V^2, \frac{1}{2}k_p' = 20\mu A/V^2,$ and $\lambda_n = \lambda_p = 0.02V^{-1}$. The values of W/L for M_1 and M_2 are 20, and those of $M_3 - M_6$ are 40. The value of V_{GSQ} is such that $I_{DS1} = 80\mu A$ and all transistors are biased in the saturation region. Determine the small-signal voltage gain $A_v = v_o / v_i$.



4. (30%) The transistor parameters are $\beta = 100, V_{BE}(on) = 0.7V$ and $V_A = \infty$.
   (a) Determine R_E such that $I_E = 150\mu A$.
   (b) Find A_d, A_{cm}, and $CMRR_{dB}$ for one-sided output at v_{O2}.
   (c) Determine the differential- and common-mode input resistances.