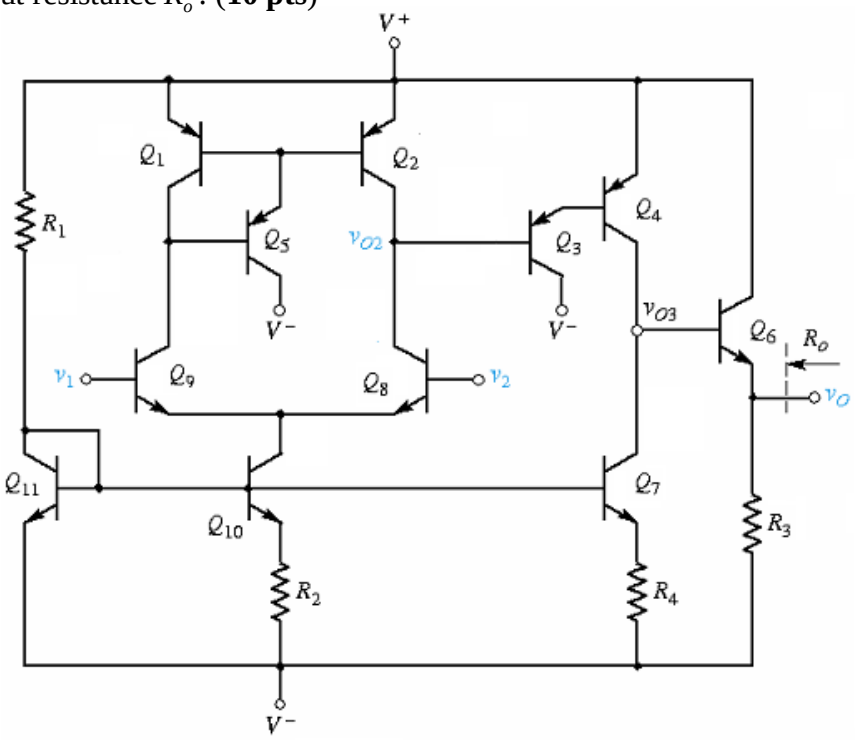
Electronics II, Exam-4, Spring 2019

Department of Communication Engineering, National Central University

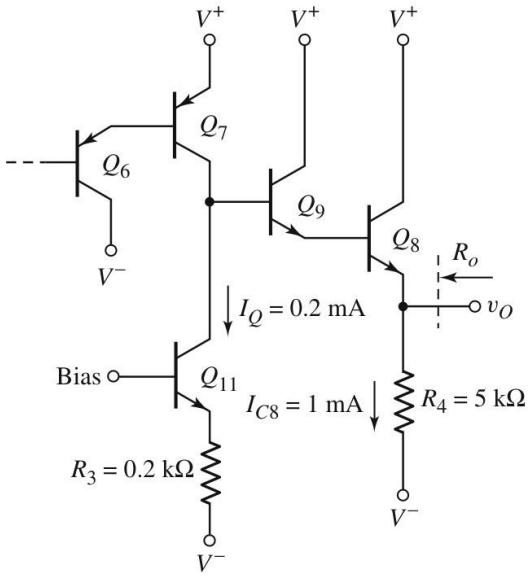
June 14, 2019, Prof. Dah-Chung Chang (E1-311)

Note: Exam time is 10:00AM-12:10PM, 2019/6/14.

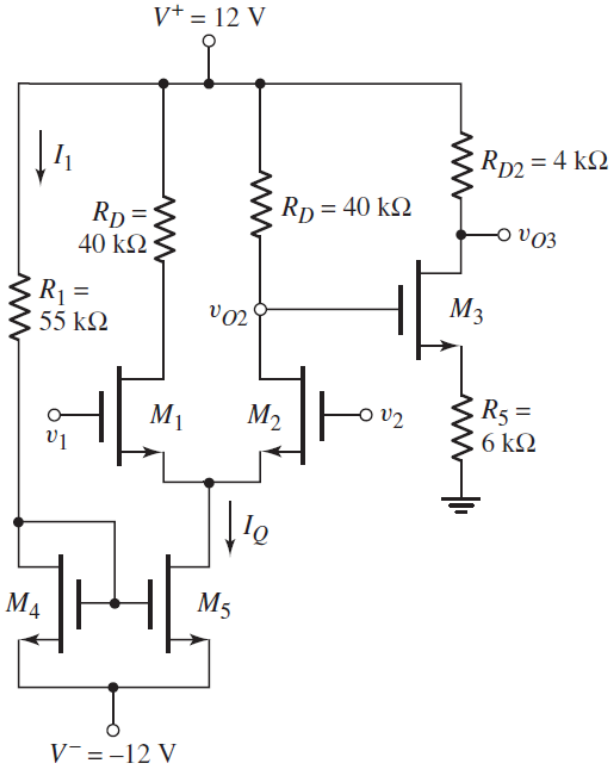
1. (**25 pts**) You have to draw the small-signal models (with corresponding transistor numbers) to explain how you derive the following answers:
   (a) Find the common-mode input resistance of v_1 and v_2. (**5 pts**)
   (b) Find the relationship of v_{O2} and $(v_1 - v_2)$. (**10 pts**)
   (c) Find the output resistance R_o. (**10 pts**)



2. (**25 pts**) Assume $\beta = 100$ for all transistors and $V_A = 100V$ for Q7 and Q11, and $V_A = \infty$ for all other transisitors. Determine the output resistance R_o.



3. (**25 pts**) Assume that the parameters of the transistors are $K_n = 0.2mA/V^2, V_{TN} = 2V$, and $\lambda = 0.02V^{-1}$. Determine the differential-mode voltage gain $A_d = v_{O3}/v_d$, where $v_d = v_1 - v_2$.



4. (**25 pts**) Consider the multistage bipolar circuit in which dc base currents are negligible. Assume the transistor parameters are β = 120, V_{BE}(on) = 0.7 V, and $V_A = \infty$.

   (a) For $v_1 = v_2 = -1.5$ V, find R, R_{E1}, R_C, and R_{E2} such that $v_{O2} = v_O = 0$, I_{CQ3} = 0.25 mA, and I_{CQ4} = 2 mA. (**10 pts**)

   (b) Assuming C_E acts as a short circuit, determine the differential-mode voltage gain $A_d = v_O/v_d$, where $v_d = v_1 - v_2$. (**15 pts**)