九十四學年度台灣大學電機系電子學(一)期末考

1. For the transistor shown in Fig. 1, assume $\beta = \infty$ and $v_{BE} = 0.5V$ at the edge of conduction. For what range of V_B does the transistor stay in active region? (13%)

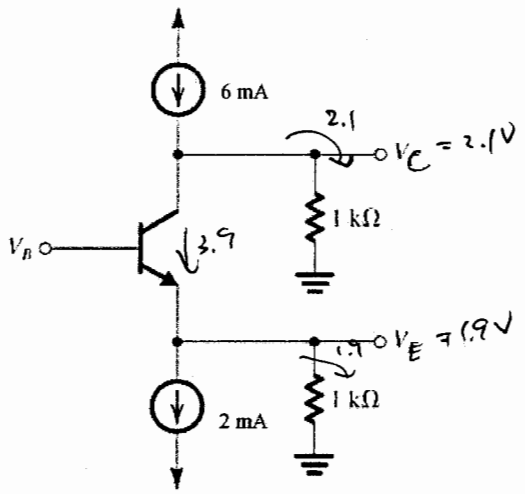

Fig. 1

2. For the circuit shown in Fig. 2, $R_1 = 9.3\ k\Omega$, $R_2 = 6.7\ k\Omega$, $R_3 = 3\ k\Omega$, $R_4 = 3.7\ k\Omega$, $R_5 = 1\ k\Omega$, $R_6 = 2\ k\Omega$. Assume all transistors $\beta = \infty$. Find the collectors current of Q_1, Q_2 and Q_3. (12%)

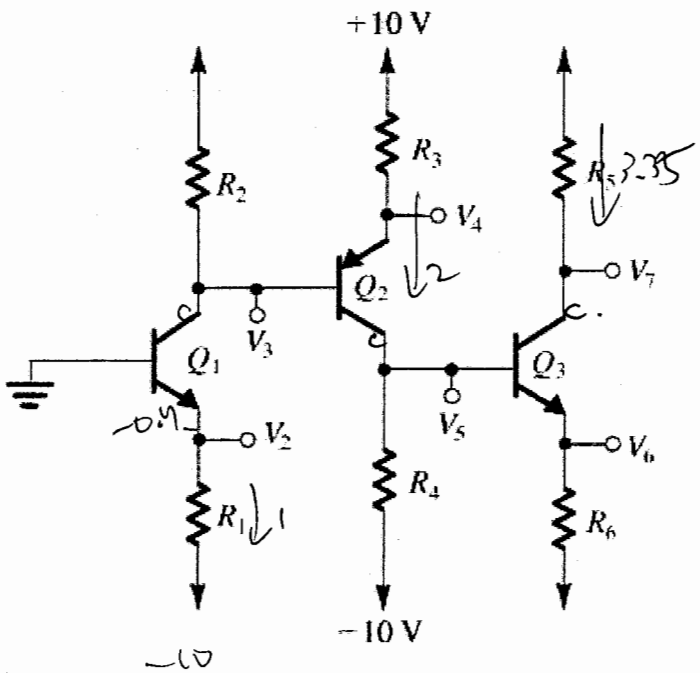

Fig. 2

3. The NMOS transistor in the common-gate amplifier of Fig. 3, has V_t =2V, k_n'W/L = 1 mA/V^2, and λ=0.

(a) Find I_D , V_D, and g_m. (12%)

(b) Find input resistance R_{in}, small signal voltage gain (v_o/v_{i2}), and output resistance R_o. (13%)

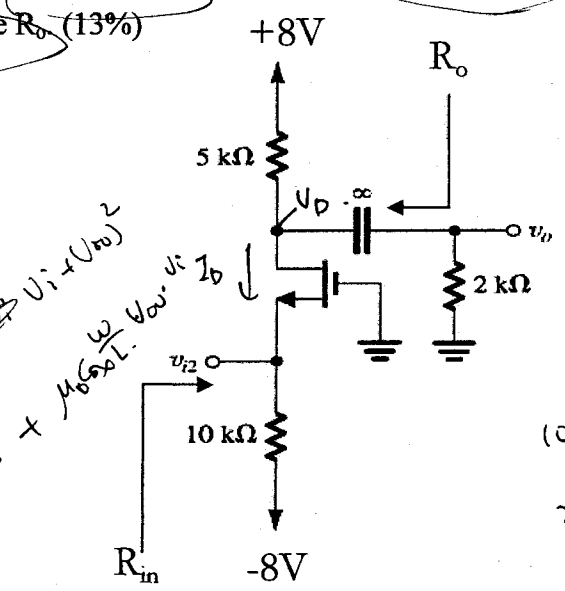

Fig. 3

4. Consider the circuit in Fig. 4. Given that $\mu_n C_{ox}$=50 μA/V^2, V_t=1 V, R_1=2 kΩ, R_2=4 kΩ, R_3=2 kΩ, $(W/L)_1$=5/1, $(W/L)_2$=20/1, $(W/L)_3$=2.5/1, $(W/L)_4$=10/1.

(a) Find I_{D2}. (5%)

(b) Find V_A and V_B. (10%)

(c) If R_3 is changed to 8 kΩ, find V_A and V_B. (10%)

Hint: neglect the body effect and channel length modulation.

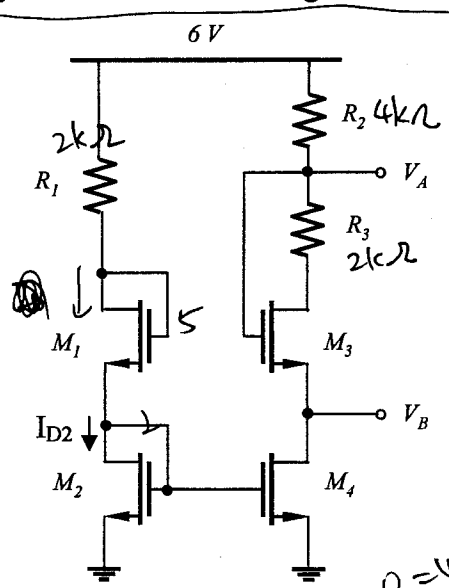

Fig. 4

5. For the circuit shown in Fig. 5, R_{B1} = 50 kΩ, R_{B2} = 100 kΩ, β_F = 100, and $|V_{BE(ON)}|$ = 0.7 V.

(a) Find the values for R_{C1}, R_{C2}, R_{E1}, and R_{E2}, such that $I_{C1} = I_{C2}$ = 0.8 mA, V_{EC1} = 3.5 V, and V_{CE2} = 4.0 V. (15%)

(b) With the R_{C1}, R_{C2}, R_{E1}, and R_{E2} determined in (a), and if R_{B1} = 100 kΩ, R_{B2} = 50 kΩ, what are the operation regions for transistors Q_1 and Q_2 (you need to derive your answer with calculations)? Assuming in the saturation region, the transistor $|V_{CE(saturation)}|$ = 0.2 V. (10%)

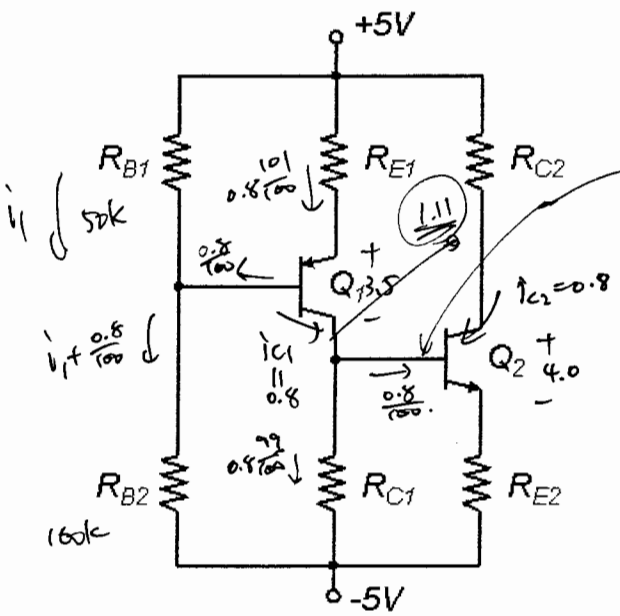

Fig. 5