電子學期末考

90.1.9. (三面, 共六題)

1. A n-channel enhancement MOSFET is measured to have a drain current of 10 mA at $V_{GS} = V_{DS} = 10V$ and of 2.5 mA at $V_{GS} = V_{DS} = 6V$. Find the values of $k_n'(W/L)$ and V_t for this device. (14%)

2. For all MOSFET's as shown in Fig. P2, $\mu_n C_{ox} = 40\ mA/V^2$, $\lambda = 0$, $V_t = 1V$, $W = 30\ \mu m$, and $L = 10\ \mu m$. The threshold voltages for enhancement MOSFET and depletion MOSFET are 1V and −1V, respectively. Find the drain currents of Q1, Q2, Q3, and voltage V_O. (21%)

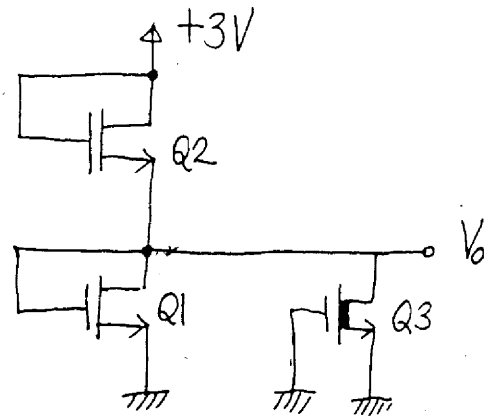
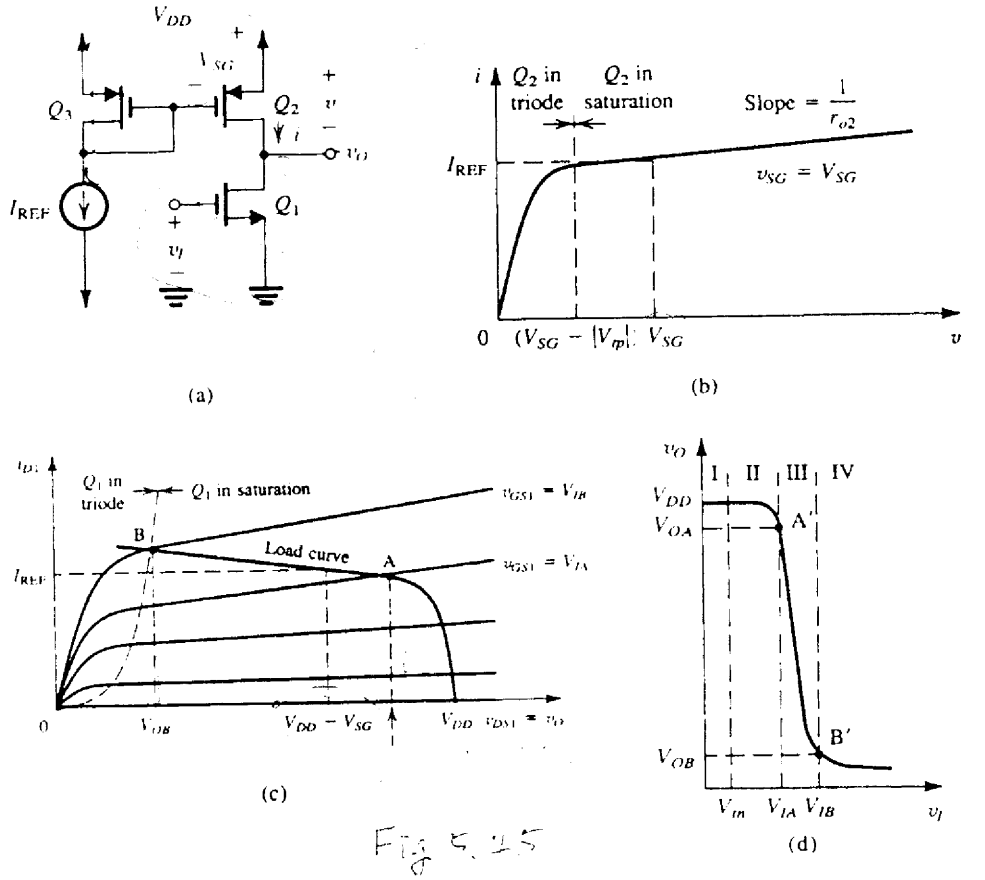


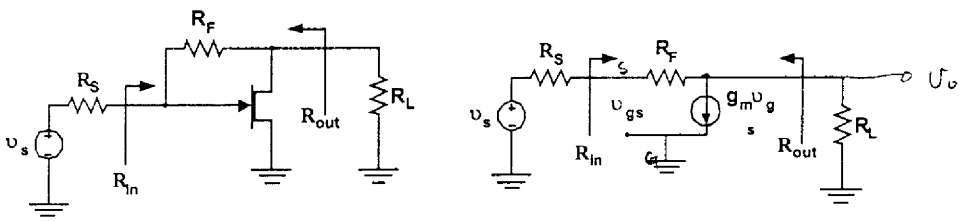
Fig. P2

3. (18%)

Consider the CMOS common-source amplifier in Fig. 5.45(a) for the case: $V_{DD} = 10$ V, $V_{tn} = |V_{tp}| = 1$ V, $\mu_n C_{ox} \simeq 2\,\mu_p C_{ox} = 20\ \mu$A/V^2, $W = 100\ \mu$m, $L = 10\ \mu$m, and $|V_A| = 100$ V for both the n and p devices, and $I_{REF} = 100\ \mu$A. Find the small-signal voltage gain. Also find the coordinates of the extremities of the amplifier region of the transfer characteristic, that is, points A′ and B′. (A′ 和 B′ 的座標)



4. (15%)



如圖(a)為 GaAs 寬頻放大器電路，常用於 Cable TV 或光纖系統，設其直流偏壓電路均已設計好 (故忽略不畫出). 其小訊號等效電路如圖(b).

(a) 求出 R_{in}

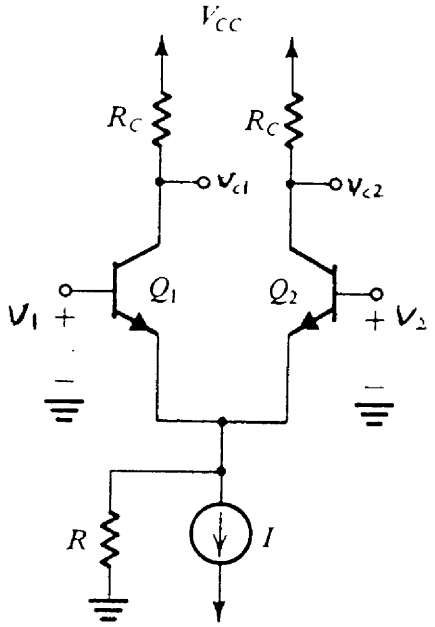
(b) 求出 R_{out}

(c) 若 $R_S = R_L = Z_O$，R_F 取為多少時，會使 $R_{in} = R_S$，$R_{out} = R_L$。

5. Simple different-pair: (see circuit below)

(a) For the singe ended output $v_o=v_{c1}$, find the A_d and A_{cm} using half circuit method. (10%)

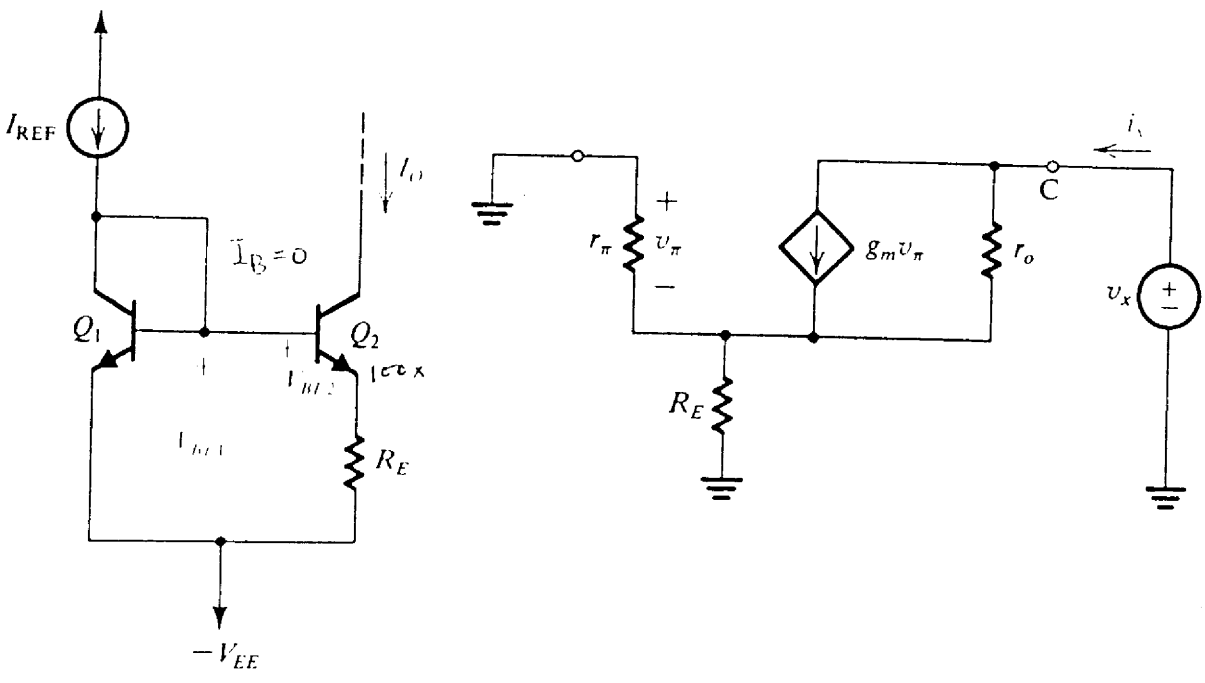
(b) Let $v_o=A_1v_1+A_2v_2$, please find A_1 and A_2 in terms of A_d and A_{cm}.(5%)



6. **Widlar current circuits:**

(a) The area of Q_2 is 100 times of Q_1, please find the R_E in terms of I_{REF}, I_o, and V_T. (10%) ($I_B=0$)

(b) Find the output resistance using the ac equivalent circuit below. (10%)



Good luck !!