國立成功大學 工程科學系 試題

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計算題 4 題(100 分，共 3 頁)。推導過程須要詳細寫出來，若觀念正確，才能斟酌給分。

1. The differential amplifier circuit shown in Fig.1 has $|V_{BE}| = 0.7V$, $\beta \gg 1$, and r_o is neglected .

   (a) For $v_1 = \frac{v_{id}}{2}$ *and* $v_2 = \frac{-v_{id}}{2}$, find the differential gain $\left|\frac{v_o}{v_{id}}\right|$. (7%)

   (b) For $v_1 = v_2 = v_{icm}$, find the common-mode gain $\left|\frac{v_o}{v_{icm}}\right|$ and CMRR . (13%)

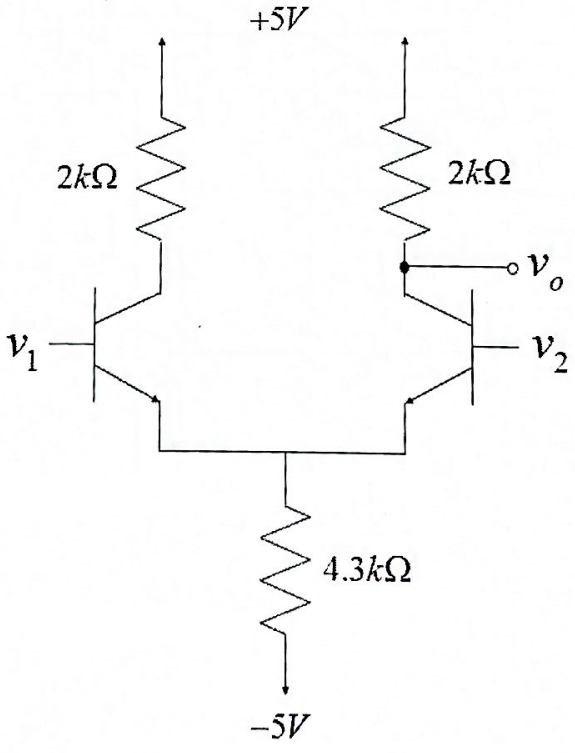

Fig.1

V1 V2 = 0V

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2. In the four-stage OP amplifier as shown in Fig.2, all transistors have $\beta = 99$, $|V_{BE}|$=0.7V, and r_o is neglected. Note that Q_6 has two times the EBJ area of those of Q_3 and Q_9 .

(a) Find the value of *DC* current $I_1 \sim I_4$. (you can assume $\beta = \infty$). (8%)

(b) Find the gain of stage1 $A_1 \equiv \frac{v_{o1}}{v_{id}}$. (10%)

(c) Find the gain of stage2 $A_2 \equiv \frac{v_{o2}}{v_{o1}}$. (10%)

(d) Find the overall gain $A_d \equiv \frac{v_o}{v_{id}}$. (12%)

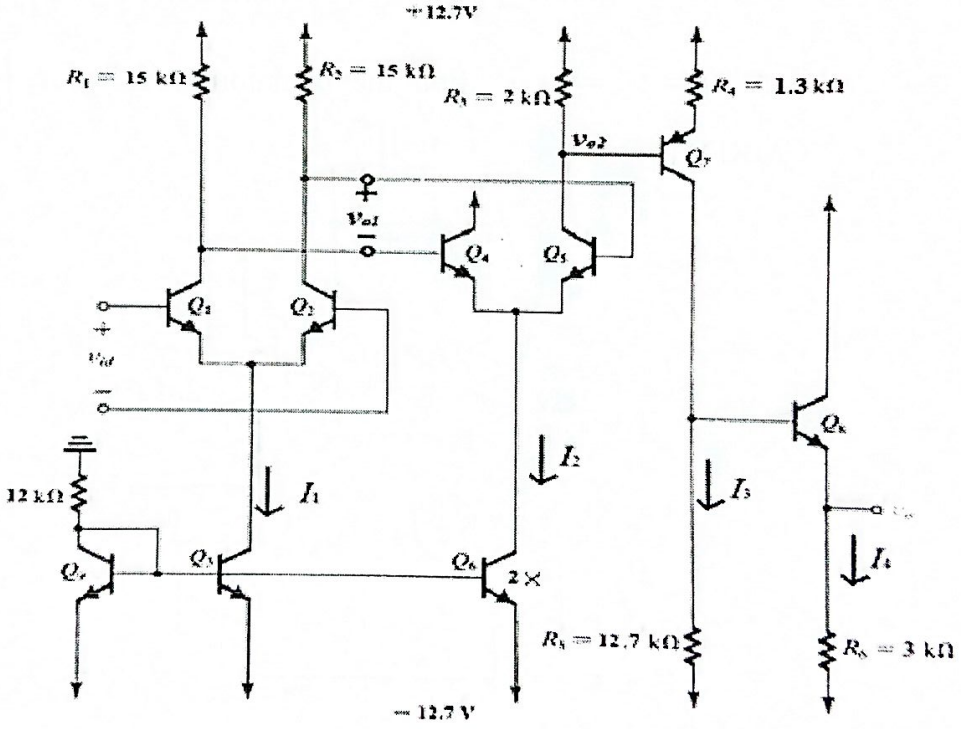

Fig.2

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3. For the BJT differential amplifier shown in Fig.3, $\beta_1 = \beta_2 = 100$, the current source has an output resistance of 200kΩ. (r_o is neglected)

(a) Find $R_{id} \equiv \frac{v_{id}}{i_{id}}$, $|A_d| \equiv |\frac{v_o}{v_{id}}|$. (10%)

(b) Find $R_{icm} \equiv \frac{v_{icm}}{i_{icm}}$, $|A_{cm}| \equiv |\frac{v_o}{v_{icm}}|$, and CMRR. (15%)

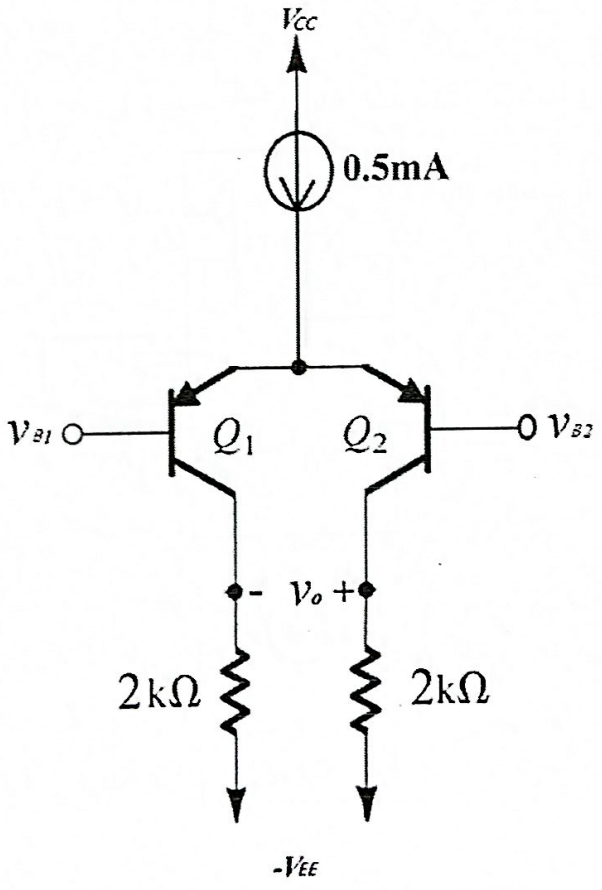

Fig.3

4. A current-mirror-loaded MOS differential amplifier shown in Fig.4 is specified as follows: $(W/L)_n = 200$, $(W/L)_p = 200$, $\mu_n C_{ox} = 2\mu_p C_{ox} = 0.2\text{mA/V}^2$, $V_{An} = |V_{Ap}| = 40\text{V}$, and $I =$ 1.6mA. Calculate $G_m \equiv \frac{i_o}{v_{id}}$ (neglect r_o), R_o, and $A_d \equiv |\frac{v_o}{v_{id}}|$.(15%)

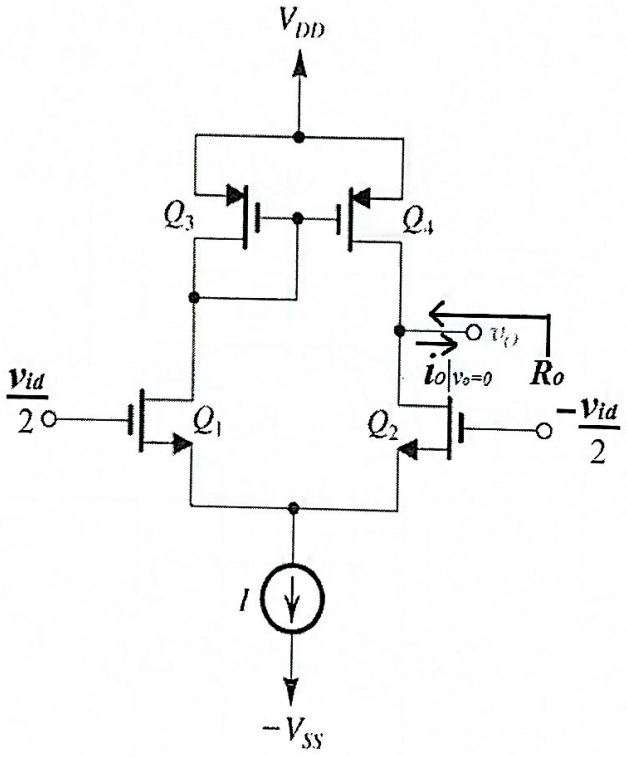

Fig.4