

國立臺灣師範大學 106 學年度碩士班招生考試試題

科目：電子學

適用系所：電機工程學系

注意：1.本試題共 3 頁，請依序在答案卷上作答，並標明題號，不必抄題。2.答案必須寫在指定作答區內，否則依規定扣分。

1. (20 points) Assuming the op amp is ideal in the circuit in Fig. 1, find the voltage gain v_o/v_i and input resistance R_{in} .

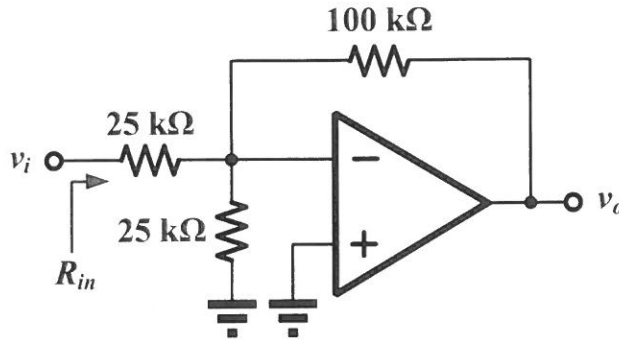


Fig. 1

2. (20 points) It is required to operate the transistor in the circuit of Fig. 2 at the edge of saturation with $I_D = 0.05\text{ mA}$. If $V_t = 0.4\text{ V}$, find the required value of R_D .

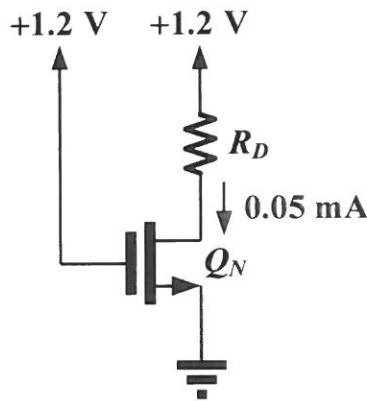


Fig. 2

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3. (20 points) For the circuit in Fig. 3, where $\mu_n C_{ox} = 4\mu_p C_{ox} = 280 \mu\text{A}/\text{V}^2$, $V_{tn} = |V_{tp}| = 0.5 \text{ V}$, $\lambda_n = \lambda_p = 0$, and $(W/L)_n = (W/L)_p = 3$. Find the current I_1 and the voltage V_2 labeled.

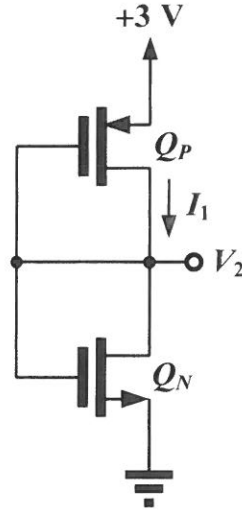


Fig. 3

4. (20 points) The NMOS transistor in the circuit of Fig. 4 has $V_t = 0.5 \text{ V}$, $\mu_n C_{ox} W/L = 2 \text{ mA}/\text{V}^2$, and $V_A = 30 \text{ V}$.
- (a) Neglecting the dc current in the feedback network and the effect of r_o , find V_{GS} . Then find the dc current I_F in the feedback network to verify that you were justified in neglecting the current in the feedback network.
- (b) Evaluate the g_m value using the V_{GS} found in (a). Then, find the small-signal voltage gain, v_o/v_{sig} , of this circuit without neglecting the effects of r_o and the feedback network.

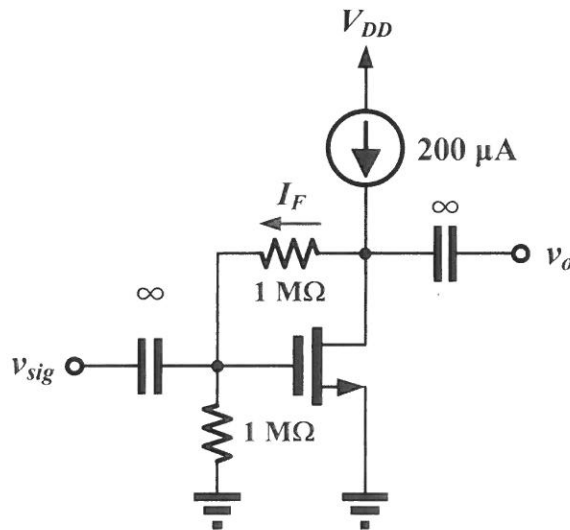


Fig. 4

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5. (20 points) The differential amplifier of Fig. 5 is biased with $I = 100 \mu\text{A}$. All transistors have $L = 2 \mu\text{m}$, and Q_1 and Q_2 have $W/L = 50$. All transistors are operated in saturation region. The circuit is fabricated in a process for which $\mu_n C_{ox} = 200 \mu\text{A}/\text{V}^2$ and $|V'_A| = 5 \text{ V}/\mu\text{m}$. Find $g_{m1,2}$, r_{o2} , r_{o4} , and $A_d = v_o/v_{id}$.

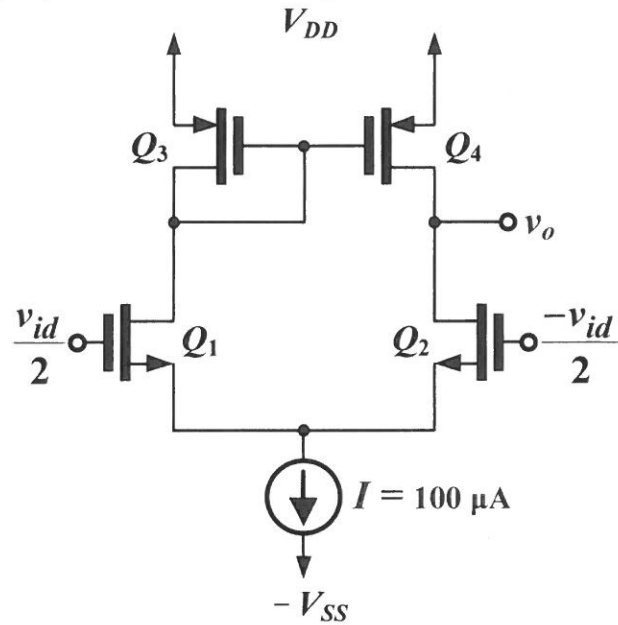


Fig. 5