

國立臺灣師範大學 114 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. (15 points) Figure 1 shows an OPA amplifier. Assume that the OPAs are ideal, $R_1 = 2 \text{ k}\Omega$, $R_2 = 6 \text{ k}\Omega$, $R_3 = 4 \text{ k}\Omega$, $R_4 = 2 \text{ k}\Omega$, and $R_L = 1 \text{ k}\Omega$.

(a) Find the input resistance R_{in} .

(b) If $v_i = 2\sin 100t$, find v_o and the power consumed on R_L .

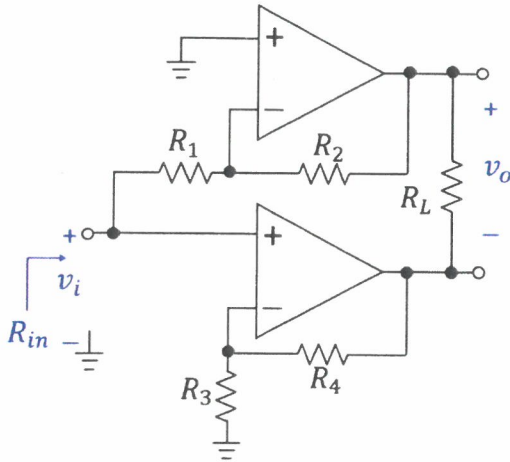


Figure 1

2. (20 points) Figure 2 shows a common-base BJT amplifier. Assume that $V_{CC} = V_{EE} = 5 \text{ V}$, $R_{sig} = 100 \Omega$, $R_C = 2 \text{ k}\Omega$, $R_E = 4.3 \text{ k}\Omega$, and $R_L = 4 \text{ k}\Omega$. The transistor is characterized by $\beta = 100$, $V_{BE} = 0.7 \text{ V}$, the thermal voltage $V_T = 25 \text{ mV}$, and $r_o = \infty$.

(a) Find I_C and g_m .

(b) Find R_{in} and v_o/v_{sig} .

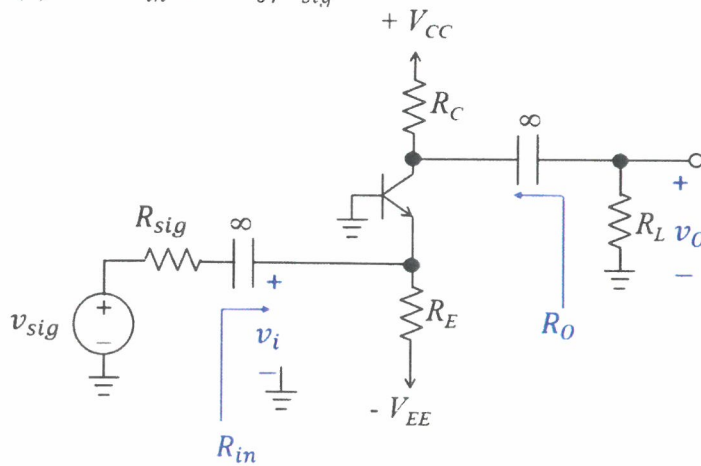


Figure 2

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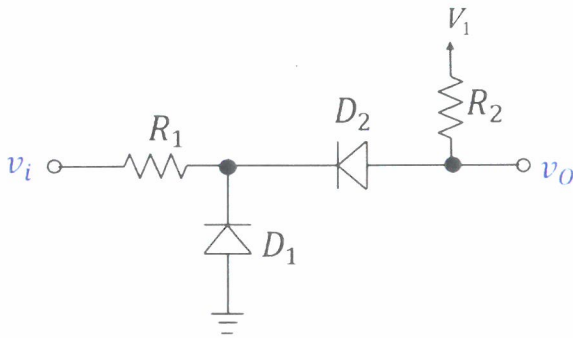
3. (15 points) For the circuits in Figure 3, answer the following questions.

(a) For Fig. 3(a), assume that $V_1 = 3\text{ V}$, $R_1 = 8\text{ k}\Omega$, $R_2 = 4\text{ k}\Omega$, and the diodes are ideal. If $v_i = -3\text{ V}$, find v_o .

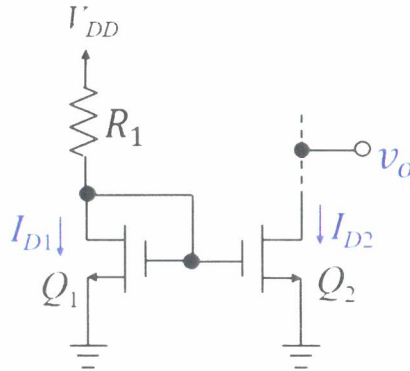
(b) For the current mirror in Fig. 3(b), assume that $V_{DD} = 7\text{ V}$, $Q_1 = Q_2$, $\mu_n C_{ox} = 200\text{ }\mu\text{A/V}^2$, $L = 0.2\text{ }\mu\text{m}$, $W = 1\text{ }\mu\text{m}$, and $V_{tn} = 1\text{ V}$. Also, assume that Q_2 is operating in the saturation region.

(i) If $R_1 = 2\text{ k}\Omega$, find I_{D1} .

(ii) If $I_{D2} = 0.5\text{ mA}$, find R_1 .



(a)



(b)

Figure 3

4. The MOSFET in the amplifier of Fig. 4 is biased to operate in the saturation region with $g_m = 2\text{ mA/V}$. Neglect r_o and assume $C_S = 3.18\text{ }\mu\text{F}$.

(a) (5 points) Determine the midband voltage gain, v_o/v_i , for $R_D = 10\text{ k}\Omega$.

(b) (10 points) Determine the pole frequency caused by C_S (in Hertz).

(c) (10 points) What is the frequency of the transmission zero introduced by C_S (in Hertz)?

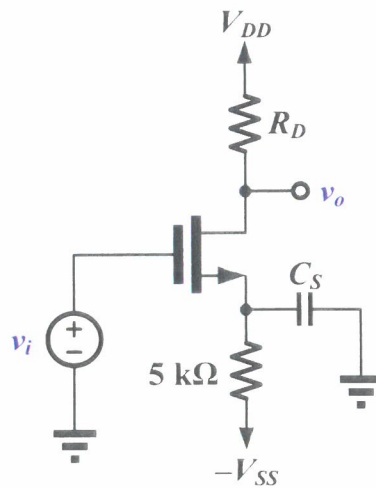


Fig. 4

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5. All transistors in the feedback transconductance amplifier shown in Fig. 5 operate in the saturation region, with $g_{m1} = g_{m2} = 4 \text{ mA/V}$. Assume $R_D = 20 \text{ k}\Omega$, $r_{o2} = 20 \text{ k}\Omega$, $R_F = 100 \text{ }\Omega$, and $R_L = 1 \text{ k}\Omega$. For simplicity, neglect r_{o1} and take r_{o2} into account only when calculating output resistances.
- (a) (5, 5, and 5 points) Determine the values of A , β , and $A_f = I_o/V_s$.
- (b) (5, 5 points) Evaluate R_o and R_{of} .

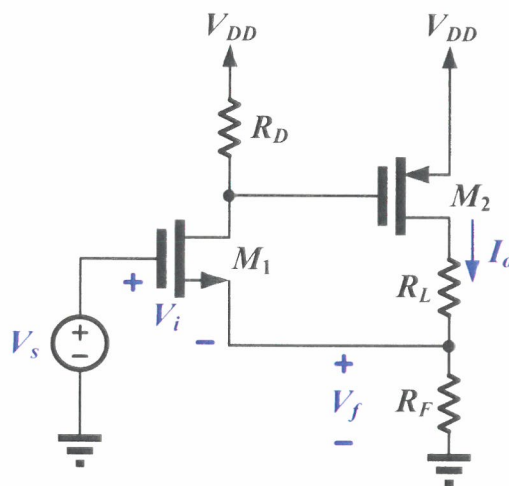


Fig. 5