國立臺北科技大學

九十二學年度光電技術研究所入學考試

電子學試題

填准考證號碼

注意事項：

1. 本試題共【8】題，配分共 100 分。
2. 請按順序標明題號作答，不必抄題。
3. 全部答案均須答在答案卷之答案欄內，否則不予計分。

1. [10%]

Figure 1 shows a generalization of the noninverting configuration, where a resistive network having a transfer function $\beta \equiv V_1/V_0$ is connected in the negative feedback path of the op amp.

(a) Show that if the open-loop gain A is infinite, then the closed-loop gain $V_0/V_s = 1/\beta$. (3%)

(b) Derive an expression for the closed-loop gain assuming A is finite. (3%)

(c) If the op amp is internally compensated such that $A \approx \omega_t/s$, show the 3-dB frequency f_{3dB} of the closed-loop gain is βf_t. (4%)

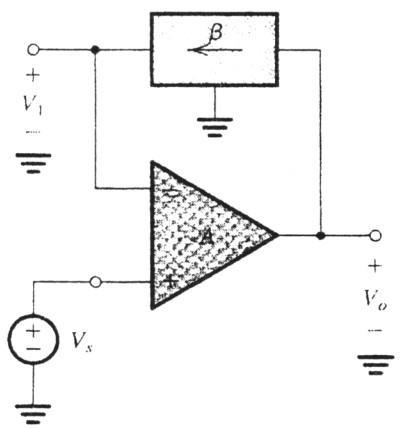

Fig. 1

2. [10%]

Assuming the diodes to be ideal, find the values of I and V in the circuits of Fig. 2.

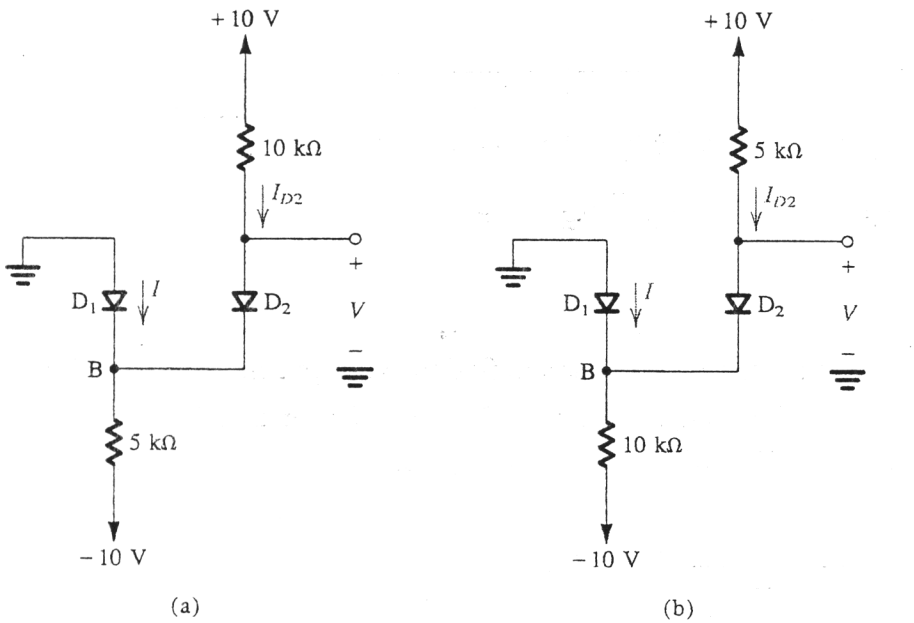

Fig. 2

3. [15%]

For the circuit in the Fig. 3, let $|V_t| = 2V$. For each of the cases

(a) $K_2 = K_1$ (7%), and

(b) $K_2 = 0.01K_1$ (8%), find Vo corresponding to $V_I = 0V$, 3V, and 6V.

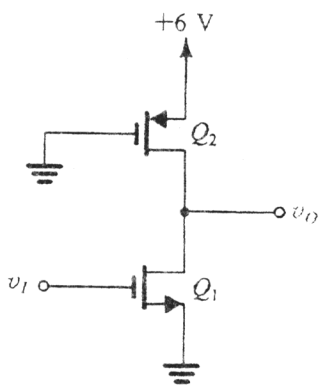

Fig. 3

4. [25%]

The equivalent circuit of an amplifier is shown in Fig. 4. The input signal source is coupled to the amplifier input via coupling capacitor C_C. Capacitor C_L represents a parasitic capacitance appearing across the load resistance R_L.

(a) Derive an expression for the amplifier voltage gain $A(s) \equiv Vo(s)/Vi(s)$. (5%)

(b) Noting that C_C is responsible for the frequency dependence of the gain at low frequencies and that C_L causes the gain to fall off at high frequencies, find the midband gain A_M, $F_L(s)$, and $F_H(s)$. (5%)

(c) For Rs = 10KΩ, Ri = 100KΩ, and R_L = 10KΩ, find the required value of Gm to

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obtain a midband gain of 20dB. (5%)

(d) Find the minimum value of C_C so that f_L is at most 10Hz. (5%)

(e) Find the maximum value that C_L can have while f_H is at least 1MHz. (5%)

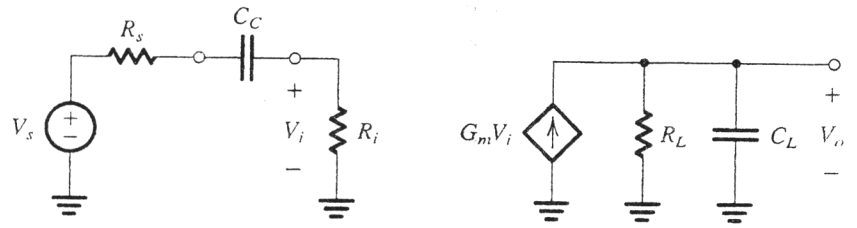

Fig. 4

5. [10%]

For the circuit of Fig. 5, use the feedback method to find the voltage gain Vo/Vs (4%), the input resistance R'_{if} (3%), and the output resistance R'_{of} (3%). The op amp has open loop gain $\mu = 10^4$ V/V, Rid = 100KΩ, Ricm = ∞, and ro = 1KΩ.

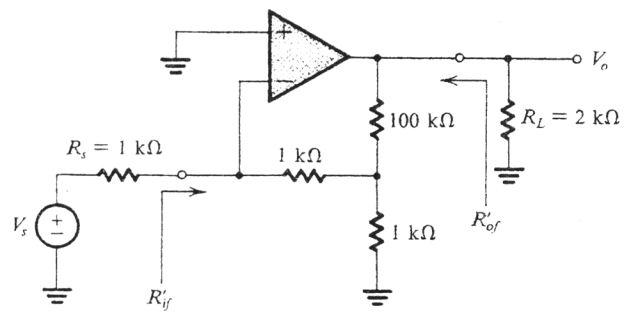

Fig. 5

6. [10%]

Figure 6 shows an enhancement-MOSFET class AB output stage. All transistors have $|V_t| = 1V$ and $K_1 = K_2 = nK_3 = nK_4$. Also, $K_3 = 1mA/V^2$. For $I_{bias} = 100\mu A$ and $R_L = 1K\Omega$, find the value of n that results in a small-signal gain of 0.99 for output voltages around zero, and the corresponding value of I_Q.

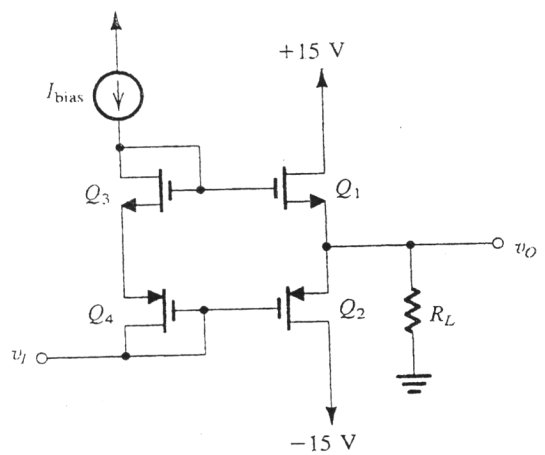

Fig. 6

7. [5%]

A particular transistor having a thermal resistance $\theta_{JA} = 2℃/W$ is operating at an ambient temperature of 30℃ with a collector-emitter voltage of 20V. If long life requires a

maximum junction temperature of 130℃, what is the corresponding device power rating? (2%) What is the greatest average collector current that should be considered? (3%)

8. [15%]

Consider the bandpass circuit shown in Fig. 7. Let $C_1 = C_2 = C$, $R_3 = R$, $R_4 = R/4Q^2$, $CR = 2Q/\omega_0$, and $\alpha = 1$. Disconnect the positive input terminal of the op amp from ground and apply Vi through a voltage divider R_1, R_2 to the positive input terminal. Analyze the circuit to find its transfer function Vo/Vi. Find the voltage-divider ratio $R_2/(R_1+R_2)$ so that the circuit realizes (a) an all-pass function (7%), and (b) a notch function. Assume the op amp to be ideal. (8%)

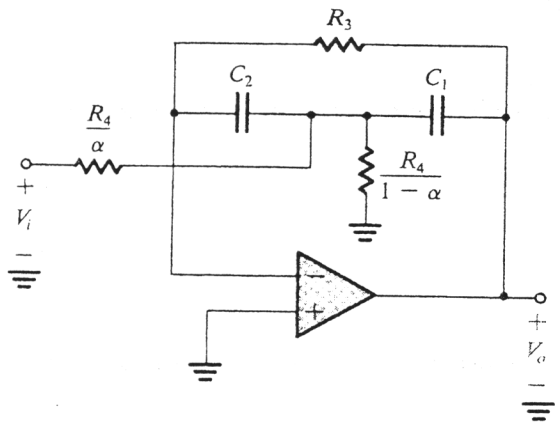

Fig. 7