本試題是否可以使用計算機： ☑可使用 ， □不可使用 （請命題老師勾選）

1. Consider the circuit in Fig. 1. The transistor parameters are $V_{TN} = 1$ V and $k_n' = 36$ $\mu A/V^2$. Determine the width-to-length ratio required in transistor $M_2$ such that $I_D$ = 0.5 mA, $V_1 = 2$ V, and $V_2 = 5$ V. (10%)

2. For the TTL circuit in Fig. 2, assume parameters of $\beta_F = 50$, $\beta_R = 0.1$, $V_{BE}(on) =$ 0.7 V, $V_{BE}(sat) = 0.8$ V, and $V_{CE}(sat) = 0.1$ V. Determine the power dissipated in the circuit (no load condition) for (a) $V_{in} = 0.1$V and (b) $V_{in} = 5$ V. (20%)



**Fig. 1**          **Fig. 2**
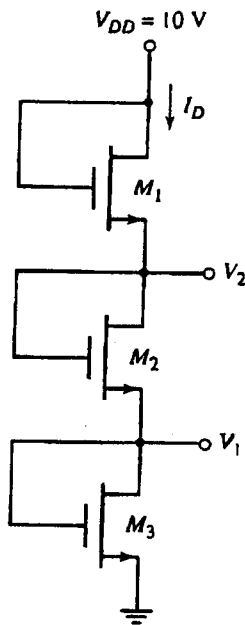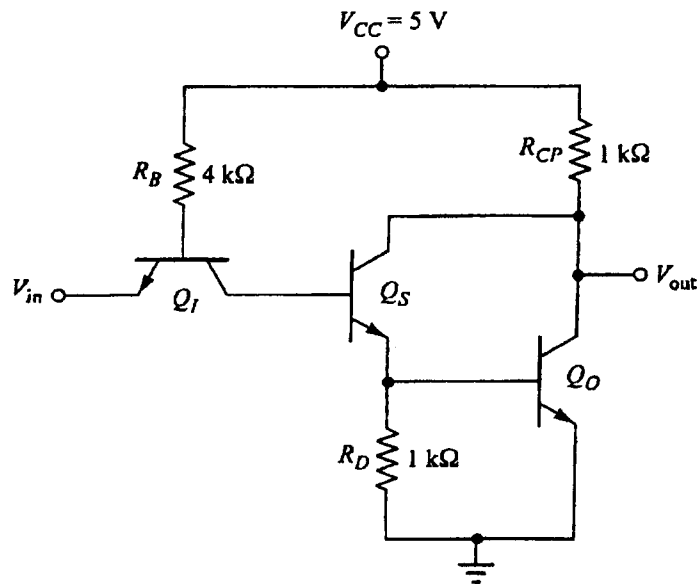
3. (a) Why the current of a forward-biased p-n junction is an exponential function of the bias voltage? (5%)

   (b) Calculate the overall voltage gain of a common-source amplifier for which $g_m = 2.5\, mA/V$, $r_o = 100\, k\Omega$, and $R_G = 1000 R_D = 10\, M\Omega$. Assume the amplifier is fed from a signal source with a Thevenin resistance of $0.5\, M\Omega$, and the amplifier output is coupled to a load resistance of $25\, k\Omega$. (5%)

   (c) For the circuit shown in Fig. 3, draw the possible load line of the Schottky transistor and explain the advantage(s) of using such a Schottky transistor in this circuit. (10%)

4. (a) Assume $V_{CC} = 15\,V$ 、 $V_{BE} = 0.7\,V$ 、 $R_1 = 2R_2 = 100\,k\Omega$, $\beta_{dc} (\equiv I_C / I_B) = 75$, and $R_C = 3R_E = 6\,k\Omega$ for the circuit shown in Fig. 4, calculated $V_{CE}$ and $I_C$. (10%)

   (b) Assume the circuit shown in Fig. 5 has matched BJTs, derive the small-signal input resistance $R_i$, output resistance $R_o$, and current gain $A_i (=i_o / i_i)$. (7%)

（背面仍有題目,請繼續作答）

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國立成功大學九十六學年度碩士班招生考試試題    共 2 頁，第 2 頁

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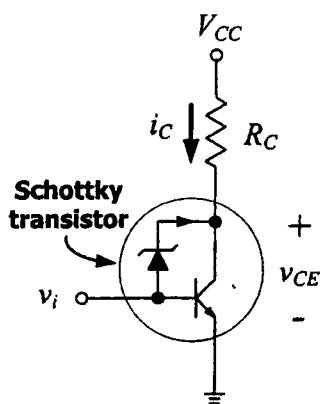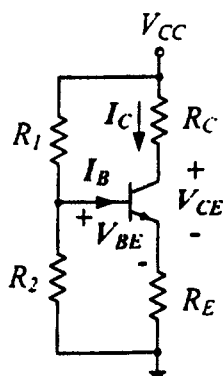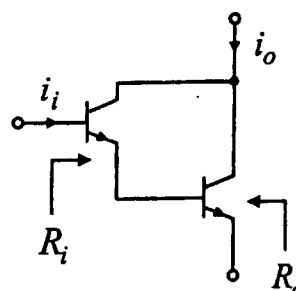


**Fig. 3**  **Fig. 4**  **Fig.5**

5. We need an amplifier with a rise time of 300 ns. The amplifier we have has rise time of 3 $\mu s$ and gain of 40. Find the resulting feedback factor $\beta$, if we correct the rise time problem with negative feedback. (5%)

6. We have a nonfeedback amplifier with voltage gain of 920, $R_o = 3k\Omega$

   and $R_i = 11k\Omega$. (a)Determine the class of feedback amplifier so that $R_{of} \le 10\Omega$

   and $R_{if} \ge 800k\Omega$. (4%) (b)Find the feedback factor $\beta$ and closed-loop gain $A_f$ of

   the feedback amplifier. (4%)

7. Consider the circuit shown in Fig. 6, Let
   $R_1 = 2k\Omega, R_2 = 667\Omega, R_3 = 200k\Omega, C = 0.1\mu F$. Assume that op amp is ideal.

(a) Find $\dfrac{V_o}{V_i}$ as a function of passive components $R_1$, $R_2$, $R_3$ and C. (8%)

(b) Find the zeros and poles of this transfer function. (4%)

(c) Plot the magnitude response of this transfer function. (8%) (Note: you have to show some numerical values at the important points on this plot to get the grade points).
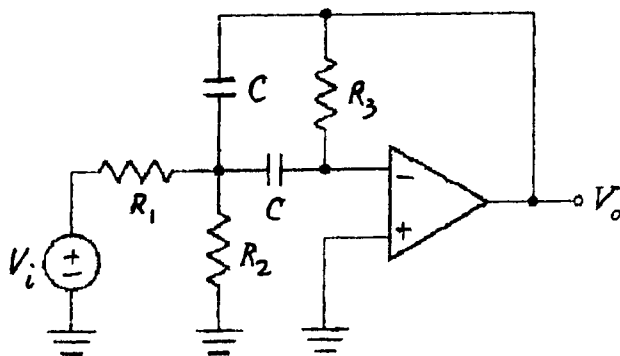


**Fig. 6**