國立彰化師範大學 98 學年度碩士班招生考試試題

系所：光電科技研究所　　科目：乙、電子學

☆☆請在答案紙上作答☆☆　　共 2 頁，第 1 頁

1. (a) Figure 1 shows the circuit with general impedances around the operational amplifier. V_{out}/V_{in} = ?
   (b) Figure 2 shows the circuit with general impedances around the operational amplifier. V_{out}/V_{in} = ? (20%)
2. Assuming $V_{in} = V_P \sin \omega t$, plot the output wavefrom of the circuit depicted in Figure 3 for an initial condition of +0.5 V across C_1. Assume V_P = 5 V. (10%)
3. In the circuit of Figure 4, $I_S = 8\times10^{-16}$ A, β = 100, and $V_A = \infty$. (a) Determine the operating point of Q_1. (b) Draw the small-signal equivalent circuit. (20%)

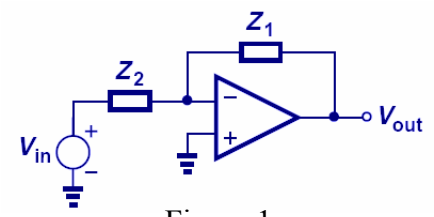

Figure 1

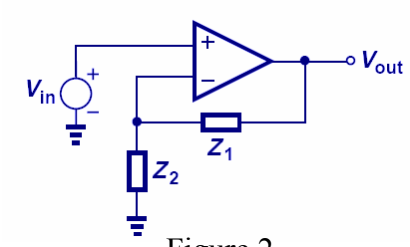

Figure 2

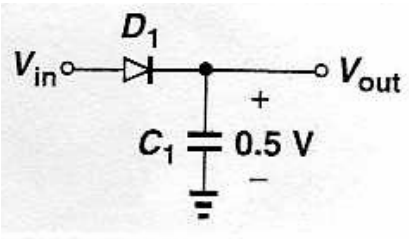

Figure 3

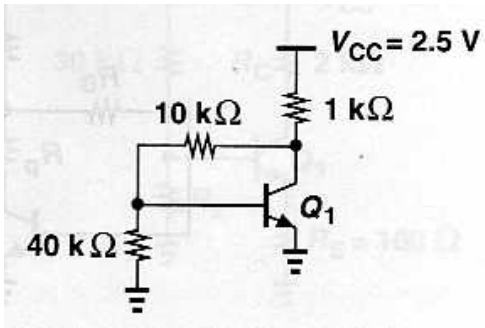

Figure 4

4. Consider an NMOS CG amplifier for which the current-source load is implemented with a PMOS transistor having an output resistance ro equal to that of the NMOS transistor. Design the circuit to obtain v_o/v_i=180 V/V and R_{in}= 5 kΩ. Assume $|V_A| = 20$ V, $\chi = 0.2$, an $k_n' = 120\ \mu A / V^2$.
   (a) Plot the small signal equivalent circuit (5%).
   (b) Specify I and W/L of the NMOS transistor. (10%).

5. For the circuit in Figure 5, let the bias be such that each transistor is operating at 125 μA collector current. Let the BJT have β = 160, f_T = 800 MHz, and C_μ = 0.2 pF, and neglect r_o and r_x. Also, $R_{sig} = R_c$ = 50 kΩ. (a) Find the low-frequency gain(5%), (b) the high frequency poles (5%), and (c) an estimate of f_H (5%). (d) Finally, Explain the meaning of 3-dB frequency (5%).

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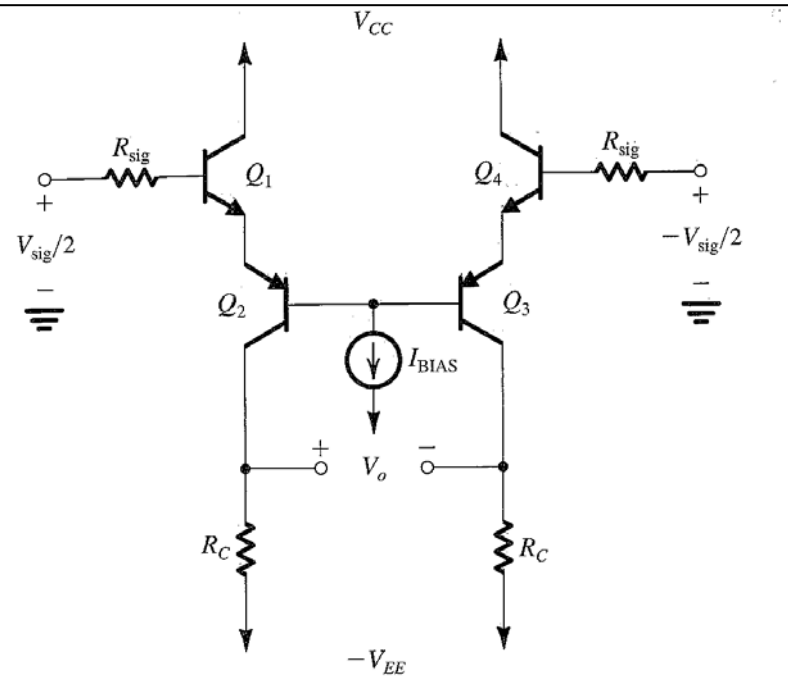

Figure 5

6. In the common gate amplifier circuit of Figure 6, Q_2 and Q_3 are matched, $k_n'(W/L)_n = k_p'(W/L)_p = 5\ mA/V^2$, and all transistors have $|V_t| = 0.5$ V and $|V_A| = 25$ V. Transistor Q_1 has $\chi = 0.2$. The signal v_{sig} is a small sinusoidal signal with no dc component.

   (a) Neglect effect of V_A, find the required value of V_{BIAS}. (5%)

   (b) Find the values of R_{in} and R_{out}. (5%)

   (c) Calculate the voltage gain v_o / v_i (5%).

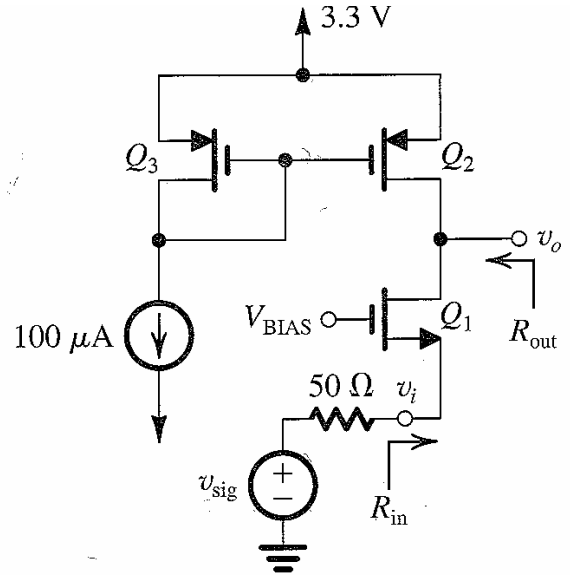

Figure 6