國立彰化師範大學 99 學年度碩士班招生考試試題

系所：電信工程學研究所　　組別：選考甲　　科目：電子學

☆☆請在答案紙上作答☆☆　　

1. Fig. 1 is a two-pole low-pass filter. Find the transfer function $T(s) = V_o(s)/V_i(s)$, where $s = j\omega$. (15%)

2. For the common-emitter amplifier shown in Fig. 2, let V_{CC} = 9 V, R_1 = 27 kΩ, R_2 = 15 kΩ, R_{E1} = 0.2 kΩ, R_{E2} = 1 kΩ, and R_C = 2.2 kΩ. The BJT has β = 100 and V_A = 100 V. Calculate the dc bias current I_E. If the amplifier operates between a source for which R_s = 10 kΩ and a load of R_L = 2 kΩ, replace the BJT with its hybrid-π model, and find the values of R_{in} and the voltage gain v_o / v_s. (20%)

3. Consider the common-source n-MOSFET amplifier shown in Fig. 3 with threshold voltage V_{th} = 1.8 V, conduction parameters $k_n = \frac{1}{2}\mu_n C_{ox}\frac{W}{L}$ = 0.15 mA/V^2, and λ = 0. (a) Calculate dc bias current I_D and voltage V_D. (b) Determine the small signal voltage gain. (c) Discuss the purpose of R_G and its effect on the small-signal operation of the amplifier. (Assume C_{C1} and C_{C2} are large enough for ac operation.) (15%)

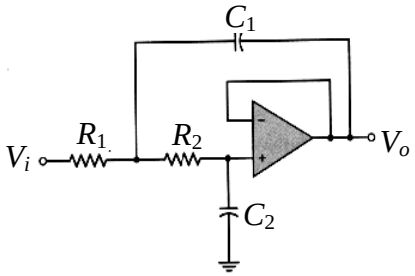

Fig. 1

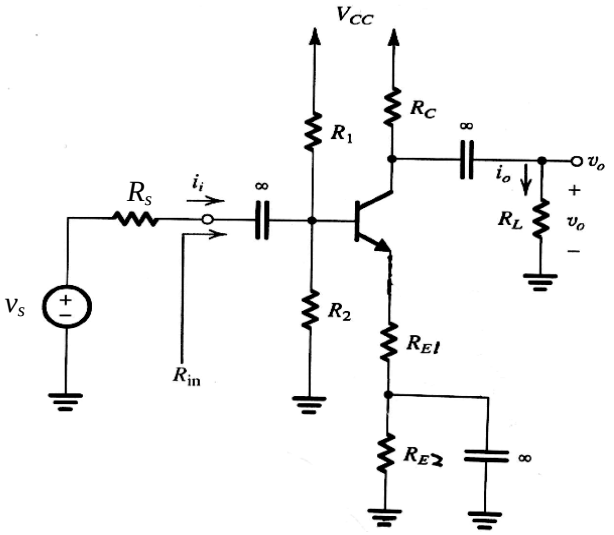

Fig. 2

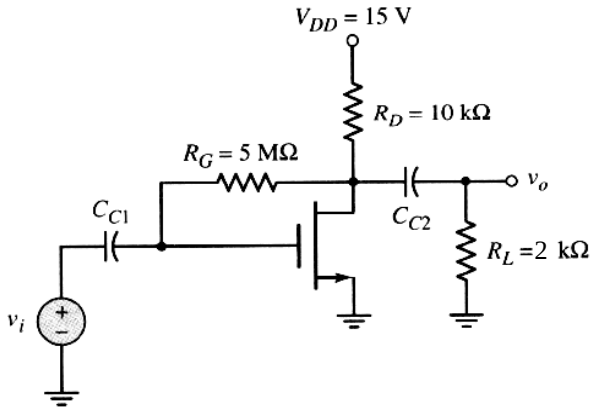

Fig. 3

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4. (a) Sketch a two inputs NOR gate of the pseudo NMOS logic structure. (7%)
   (b) What are the advantages and disadvantages of pseudo NMOS logic when it compared with CMOS logic? (8%)

5. Fig. 4 shows the circuit for determining the output resistance when v_{out} is positive and Q_3 is conducting most of the current. Neglecting the large output resistance of Q_1, find R_o when Q_3 is sourcing an output current of 2 mA. (The bias current of Q_1 is 300 μA, I_{sn}=10^{-14}A, β_n=100, V_{an}=125 V, I_{sp}=10^{-14}A, β_p=50, V_{ap}=50 V)(15%)

6. For the circuit in Fig. 5 $|V_t|$ = 1 V, $k'W/L$ = 1 mA/V^2, h_{fe} = 100, and the Early voltage magnitude for all devices (including those that implement the current sources) is 80 V. The signal source V_s has a zero dc component. Find the dc voltage at the output and at the base of Q_3(3%). Find the values of A(4%), β(4%), A_f(3%), R_{in} (3%)and R_{out}(3%).

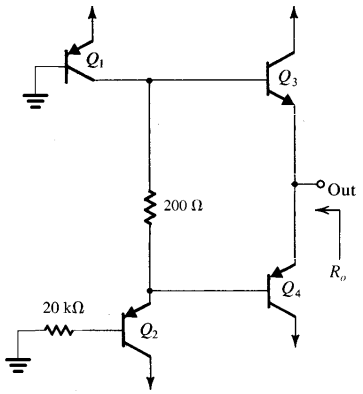

Fig. 4

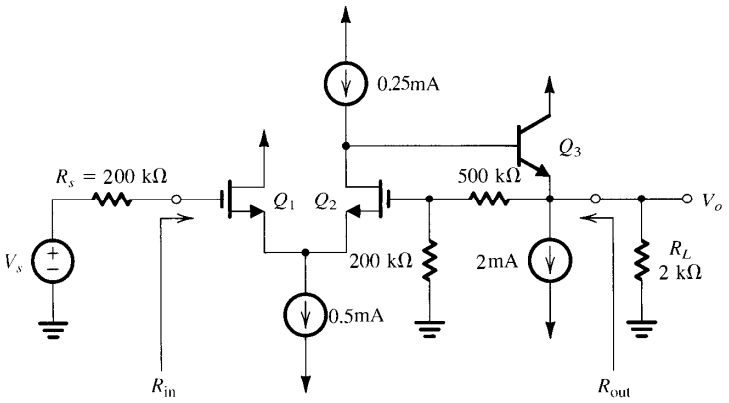

Fig. 5