國立中山大學107學年度碩士暨碩士專班招生考試試題

科目名稱：電子學【電機系碩士班甲組】　　題號：431009

※本科目依簡章規定「可以」使用計算機（廠牌、功能不拘）（問答申論題）　　

1. (20%) Figure 1 shows a MOSFET circuit with the V_{DC} = 5 V, R_{sig} = 120 kΩ, R_{G1} = 300 kΩ, R_{G2} = 200 kΩ, R_D = 2 kΩ, R_S = 1 kΩ, R_L = 1 kΩ. The threshold voltage V_{TH} and $\mu C_{ox}W/L$ of MOSFET are –1 V and 2 mA/V^2 respectively. Neglect the channel length modulation effect. (a) Please find the DC drain current I_D. (b) For AC analysis, please find the input resistance R_{in}, output resistance R_{out} and overall gain v_o/v_{sig}. (5%*4)
2. (20%) Figure 2 shows a BJT circuit with the V_{DC} = 5 V, R_{sig} = 120 kΩ, R_{B1} = 300 kΩ, R_{B2} = 200 kΩ, R_E = 5 kΩ, R_C = 2 kΩ, R_L = 5 kΩ. The BJT has $|V_{BE}| \approx 0.7$ V, β = 100, thermal voltage V_T = 25 mV. Neglect the Early effect. (a) Please find the DC collector current I_C. (b) For AC analysis, please find the input resistance R_{in}, output resistance R_{out} and overall gain v_o/v_{sig}. (5%*4)
3. (30%) The amplifier shown in Fig. 3 has V_{DC} = 1.5 V, $R_{sig} = R_L$ = 1 kΩ, R_C = 1 kΩ, R_B = 47 kΩ. The BJT has $|V_{BE}| \approx 0.7$ V, β = 100, C_μ = 0.8 pF, f_T = 600 MHz, and thermal voltage V_T = 25 mV. Assume the coupling capacitors to be very large. Neglect the Early effect. (a) Find the collector current of the transistor. (b) Find the overall gain v_o/v_{sig} and the input resistance R_{in} at midband frequency. (c) Find the high frequency response f_H. (5%,5%,10%,10%)
4. (30%) Consider the BiCMOS amplifier shown in Fig. 4 has V_{DC} = 5 V, R_{sig} = 100 kΩ, R_G = 10 MΩ, R_S = 6.8 kΩ, R_C = 3kΩ, R_L= 1 kΩ, C_1 = 0.1 μF, C_2 = 1 μF. The BJT has $|V_{BE}| \approx 0.7$ V, β = 200, C_μ = 0.8 pF, f_T = 600 MHz, and thermal voltage V_T = 25 mV. The MOSFET has V_{TH} = 1 V, $\mu C_{ox}W/L$ = 2 mA/V^2, and $C_{gs} = C_{gd}$ = 1 pF. Neglect the Early effect and channel length modulation effect. (a) Consider the DC bias circuit. Neglect the base current of Q2 in determining the current in Q1. Find the DC drain current in Q1 and collector current in Q2. (b) Consider the circuit at low frequencies. Determine the frequency of the poles due to C1 and C2. (c) Consider the circuit at higher frequencies. Use open-circuit time constants to estimate f_H. (5%,5%,5%,5%,10%)

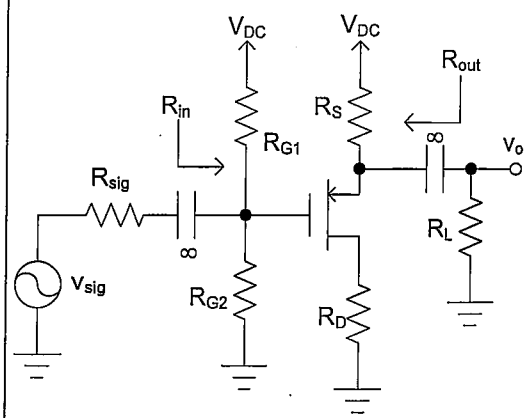

Figure 1

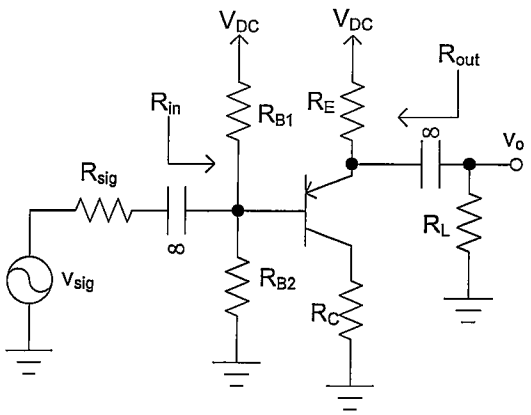

Figure 2

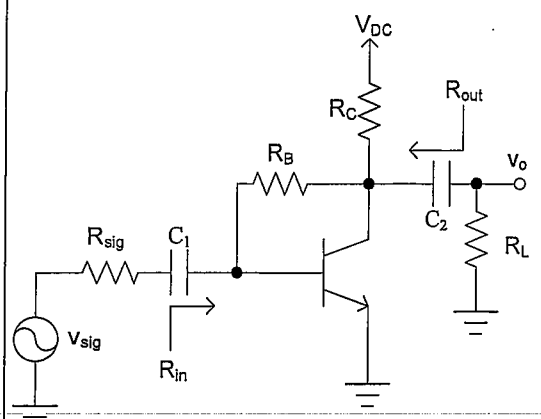

Figure 3

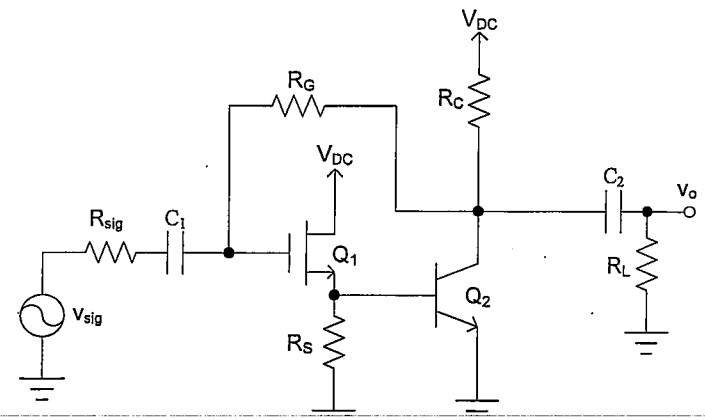

Figure 4

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