國立台灣科技大學九十五學年度碩士班招生試題

系所組別： 電子工程系碩士班乙一組、乙二組、乙三組

科　　目： 電子學

總分 100 分

1. For the transistor in the circuit in Fig. 1, the parameters are β=100 and V_A=∞. (a) Find the quiescent values of I_{CQ} and V_{CEQ}. (b) Find the small-signal parameters g_m, r_π, and r_o. (c) Find the input resistances R_{ib} and R_{is}. (d) Find the small-signal voltage gain $A_v=v_o/v_s$ and the small-signal current gain $A_i=i_o/i_s$. (V_{BE}(on)=0.7V. V_T=0.026V. Assume the capacitors C_{C1} and C_{C2} are shorted out for small signal. Also, only g_m, r_π, and r_o are used in the small-signal model of the BJT.) (20%)

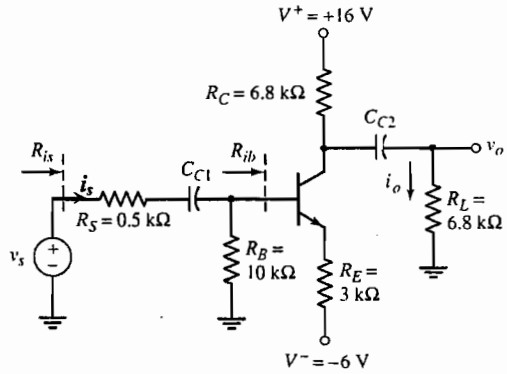

Fig. 1

2. The transistor in the source-follower circuit in Fig. 2 has parameters K_p=2mA/V^2, V_{TP}= − 2V, and λ=0.02V^{-1}. The circuit parameters are R_L=4kΩ, R_S=4kΩ, R_1=1.24MΩ, and R_2=396kΩ. (a) Calculate the quiescent values of I_{DQ}, V_{SDQ} and the small-signal parameters g_m, r_o (b) Determine the small-signal voltage gain $A_v=v_o/v_s$ and the small-signal current gain $A_i=i_o/i_s$. (c) Calculate the output resistance R_o. (Assume the capacitors C_{C1} and C_{C2} are shorted out for small signal. Also, only g_m and r_o are used in the small-signal model of the MOSFET.) (15%)

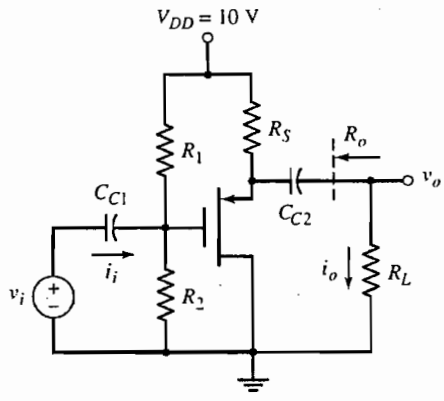

Fig. 2

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3. In the common-base circuit shown in Fig. 3, the transistor parameters are β=100, V_{BE}(on)=0.7V, V_T=0.026V, and V_A=∞, C_π=10pF, and C_μ=1pF. (a) Determine the upper 3dB frequencies corresponding to the input and output portions of the equivalent circuit. (b) Calculate the small-signal midband voltage gain. (c) If a load capacitor C_L=15pF is connected between the output and ground, determine if the upper 3dB frequency will be dominated by the C_L load capacitor or by the transistor characteristics. (Assume the capacitors C_{C1}, C_{C2} and C_B are shorted out for small signal. Also, only g_m, r_π, r_o, C_π, and C_μ are used in the small-signal model of the BJT.) (15%)

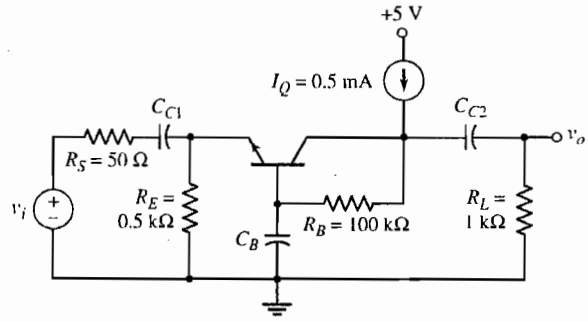

Fig. 3

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4. Figure 4 shows a simple GaAs MESFET amplifier, with the W values of the transistors indicated. Assume that the dc component of v_I, that is V_{GS1}, biases Q_1 at the current provided by the current source Q_2 so that both devices operate in saturation and that the dc output is at half of the supply voltage. Find:

(a) the β values for Q_1 and Q_2;

(b) V_{GS1};

(c) g_{m1}, r_{o1}, and r_{o2}; and

(d) the small-signal voltage gain. (20%)

TYPICAL PARAMETER VALUES FOR GaAs MESFETS AND SCHOTTKY DIODES IN L = 1 μm TECHNOLOGY, NORMALIZED FOR W = 1 μm

$V_t = -1.0$ V
$\beta = 10^{-4}$ A/V^2
$\lambda = 0.1$ V^{-1}
$I_S = 10^{-15}$ A
$n = 1.13$

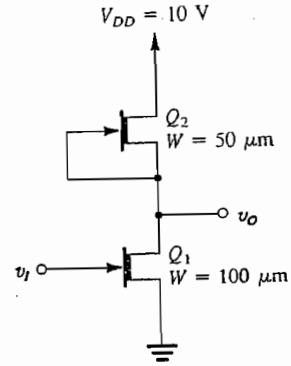

Fig. 4

5. For the op amp Schmitt trigger in Figure 5 determine the upper and lower trigger points as well as the hysteresis gap. Assume the positive and negative saturation levels of output voltage to be +11 and −11 V, respectively. (20%)

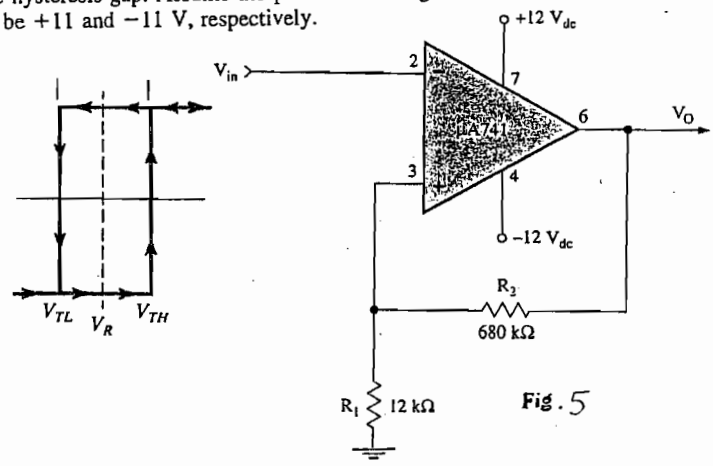

Fig. 5

6. Please explain circuit functions for Fig. 6 (10%)

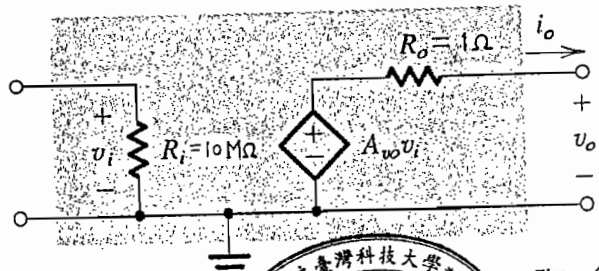

Fig. 6