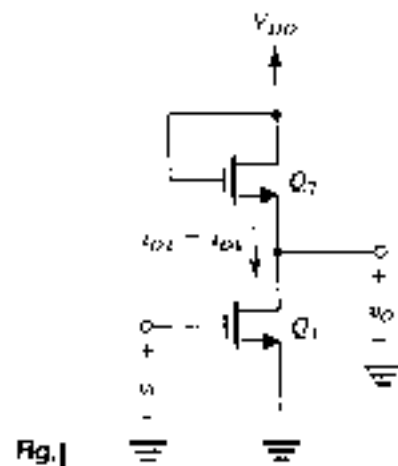
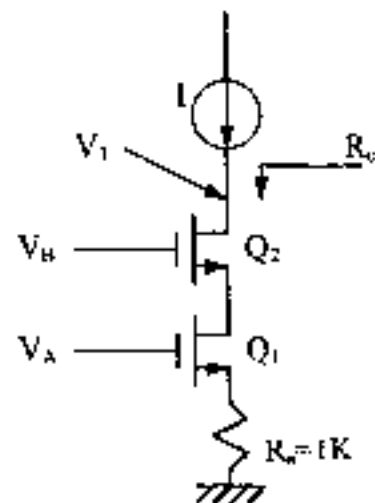


1. (a) What is the I-V characteristic of a diode-connected enhancement MOSFET? Please write down its expression and qualitatively plot the characteristic. (5%)
- (b) For the NMOS transistor with enhancement load shown in Fig. 1, please plot its transfer characteristic and explain the usage of the different regions in the characteristic (5%)
- (c) Derive the linear relation between  $v_i$  and  $v_o$  when the transistor  $Q_1$  is in saturation. Express the voltage gain in terms of device dimensions of  $Q_1$  and  $Q_2$ . (10%)
- (d) Plot the small-signal equivalent circuit of Fig. 1 for the case in (c) (5%)



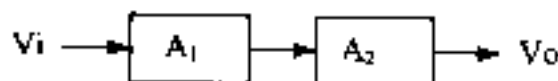
2. Two identical NMOS with parameters  $K=0.1\text{mA/V}^2$ ,  $V_t=2\text{V}$ , and  $r_o=50\text{K}\Omega$  are used in the circuit. They are operated in saturation mode using the constant bias voltages  $V_A$  and  $V_B$  which give the drain current  $I=0.4\text{mA}$ .

- (1) Determine the value  $V_A$ . (4%)
- (2) Find the minimum values for  $V_B$  and  $V_1$ . (6%)
- (3) Sketch the small signal equivalent circuit and find the expression for the output resistance  $R_o$ . (5%)

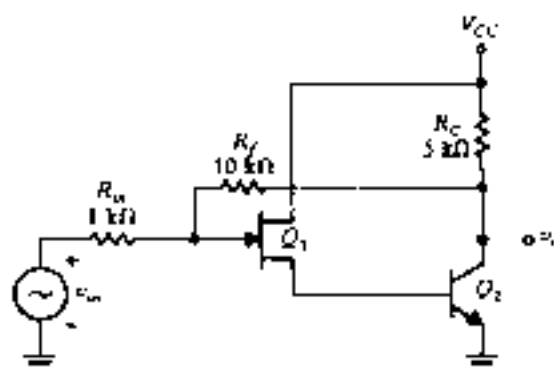


3. Two amplifiers with midband - gain  $A_1$  and  $A_2$  are connected in series. The high frequency dominant poles for  $A_1$  and  $A_2$  are  $\omega_1$  and  $\omega_2$ , respectively.
- (1) Find the high frequency response for  $T(s) = V_o(s)/V_i(s)$  of the system.
  - (2) If  $\omega_1 \ll \omega_2$ , sketch the Bode plot of  $|T(s)|$  for  $\omega$  in the range  $0.1\omega_2 < \omega < 10\omega_2$ .
  - (3) If  $\omega_1 = \omega_2$ , sketch the Bode plot of  $|T(s)|$  for  $\omega$  in the range  $0.1\omega_2 < \omega < 10\omega_2$ . (10%)

Note: You can only sketch the magnitude response of Bode plot in Probs. (2) and (3)!



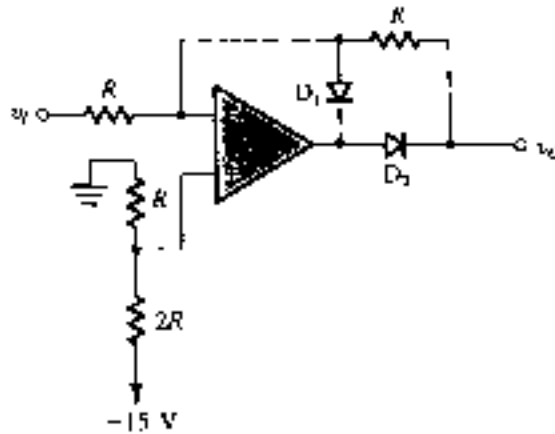
4. For the following circuit,  $g_m = 1 \text{ mA/V}$  and  $r_o = \infty$  for FET  $Q_1$ , and  $r_{\pi} = 1 \text{ k}\Omega$  and  $\beta = 100$  for BJT  $Q_2$ .
- (a) Find the circuit voltage gain  $v_o/v_{in}$  with  $R_f$  removed. (5%)
  - (b) Find the circuit voltage gain with  $R_f$  in place. (10%)



八十六學年度 電機系丙組暨電子所 組碩士班研究生入學考試

科目 電 子 學 科號 3202 共 四 頁第 3 頁 \*請在試卷【答案卷】內作答

5. Plot the transfer characteristic of the following circuit. (10%)



6. (15%) A Spice-like program is listed below without showing the value of each component

Guess who am I

C1 1 2

C2 2 0

R1 1 2

R2 2 0

Vin 1 0

Vo 2 0

Answer the following questions

(a) Draw the circuit and mark each component.

(b) What are the applications of this circuit if one of the capacitor is 0 List all the possible situations with discussions.

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7. (10%) If the data stored in the ROM are  $(C, D) = 00, 01, 10, \text{ and } 11$  as input  $(A, B) = 00, 01, 10, \text{ and } 11$ , respectively. Complete the circuit (use NMOS FETs and Ground signal)

