

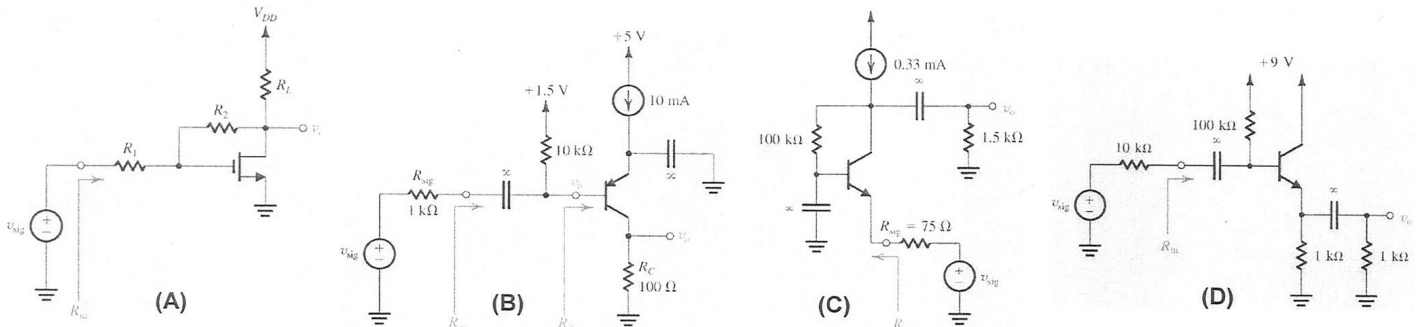
# 國立中央大學九十九學年度電機系碩士在職專班招生試題

筆試科目：基礎電子學

考試時間：100 分鐘

共 1 頁，第 1 頁

1. **選擇題** (7 分) 對一互補式金氧半電晶體反相器(CMOS inverter)而言，下列何者敘述有誤？(A)由 NMOSFET 與 PMOSFET 共同組成，(B)功率損耗較 NMOS inverter 大，(C) noise margin 較 NMOS inverter 大，(D)以上皆非。
2. **選擇題** (7 分) 對一金氧半電晶體(MOSFET)而言，下列何者敘述為真？(A)為一四端點(four terminals)元件，(B) enhancement-mode PMOSFET 之臨限電壓(threshold voltage,  $V_t$ )小於 0 V，(C)在相同的元件結構與幾何大小下，NMOSFET 之電流高於 PMOSFET (D)以上皆真。
3. **選擇題** (7 分) 下列何種電路屬於 BJT 共集極組態？



4. **計算題** (24 分) The NMOS transistors in Fig. 1 have  $V_t = 1$  V,  $\mu_n C_{ox} = 120 \mu\text{A/V}^2$ ,  $\lambda = 0$  (or  $V_A = \infty$ ), and  $L_1 = L_2 = 1 \mu\text{m}$ . Find the required values of gate width for each of  $Q_1$  and  $Q_2$  to obtain the voltage and current values indicated.

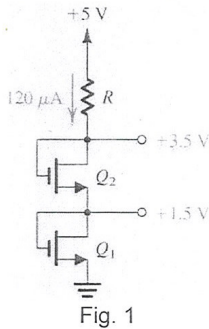


Fig. 1

Operation	NMOSFETs	PMOSFETs
Saturation	$I_d = k_n(V_{GS} - V_t)^2$	$I_d = k_p(V_{SG} + V_t)^2$
Triode	$I_{dn} = k_n[2(V_{GS} - V_t)V_{DS} - V_{DS}^2]$	$I_{dp} = k_p[2(V_{SG} + V_t)V_{SD} - V_{SD}^2]$
Transition Point	$V_{DS(sat)} = V_{GS} - V_t$	$V_{SD(sat)} = V_{SG} + V_t$
Small signal parameters:	$k_n = W\mu_n C_{ox}/2L$	$k_p = W\mu_p C_{ox}/2L$
	$g_m = 2\sqrt{k_n I_{DQ}}$	$r_o = V_A/I_{DQ}$

5. **計算題** (25 分) Figure 2 shows an ideal op-amp.

5-1 (16 分) Find  $I_1$ ,  $I_2$ ,  $I_3$ , and  $V_x$ .

5-2 (9 分) If  $V_O$  is not to be lower than -13 V, find the maximum allowed value for  $R_L$ .

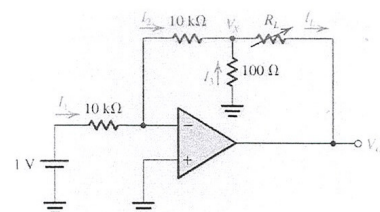


Fig. 2

6. **計算題** (10 分) For the current steering circuit of Fig. 3, find  $I_O$  in terms of  $I_{REF}$  and device  $(W/L)$  ratios, such as  $(W/L)_1$ ,  $(W/L)_2$ ,  $(W/L)_3$ , and  $(W/L)_4$ .

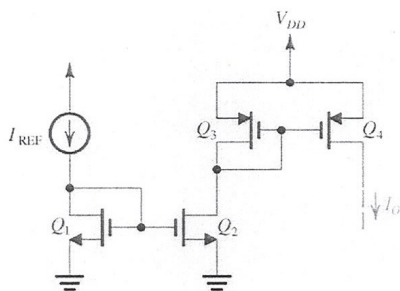


Fig. 3

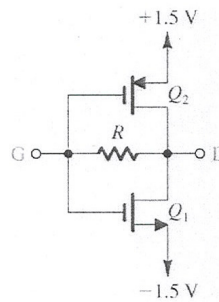


Fig. 4

7. **計算題** (20 分) The MOSFETs in the buffer amplifier shown in Fig. 4 are matched, having  $\mu_n C_{ox} (W/L)_1 = \mu_p C_{ox} (W/L)_2 = 1 \text{ mA/V}^2$  and  $|V_t| = 0.5$  V. The resistance  $R = 1 \text{ M}\Omega$ .

7-1 (10 分) For G and D open, find the values of drain currents  $I_{D1}$  and  $I_{D2}$ .

7-2 (10 分) For infinite  $r_o$ , find the voltage gain of the amplifier from G to D.