

大同大學 九十三年 學年度 轉學考試 試題

考試科目：電子學

系列：電機工程學系 第 1 頁，共 1 頁

註：本次考試 不可以參考自己的書籍及筆記； 不可以使用字典； 可以使用計算器。

1 Refer to Fig. P1, for the small signal equivalent circuit of a BJT,

(a) What is the physical meaning of r_x and r_o . (6%)

(b) If I_C (dc current) = 0.5 mA, $\beta = 50$, calculate g_m , r_π . (6%)

(c) For the CE (common emitter) configuration, derive the unity-gain bandwidth f_T . (12%)

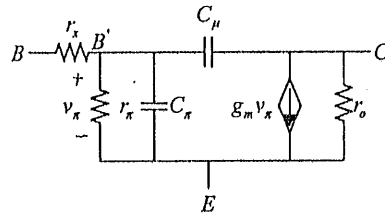


Fig. P1

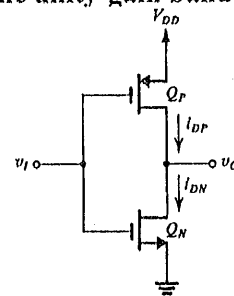


Fig. P2

2 Derive the switching threshold voltage V_{th} of the CMOS inverter in terms of V_{tn} , $|V_{tp}|$, V_{DD}

and $r = \sqrt{\frac{\mu_n C_{ox} (W/L)_n}{\mu_p C_{ox} (W/L)_p}}$, where $V_{tn}/|V_{tp}|$, threshold voltage of nMOS/pMOS. (Fig. P2) (13%)

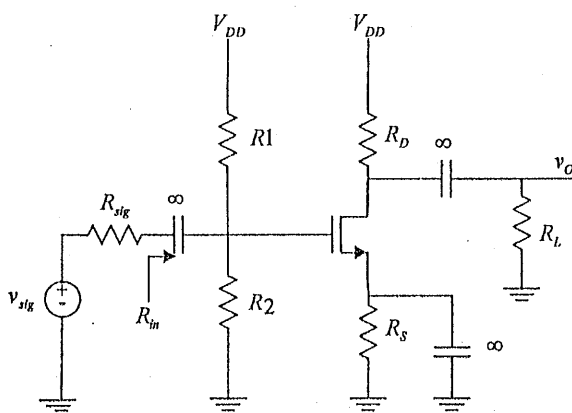


Fig. P3

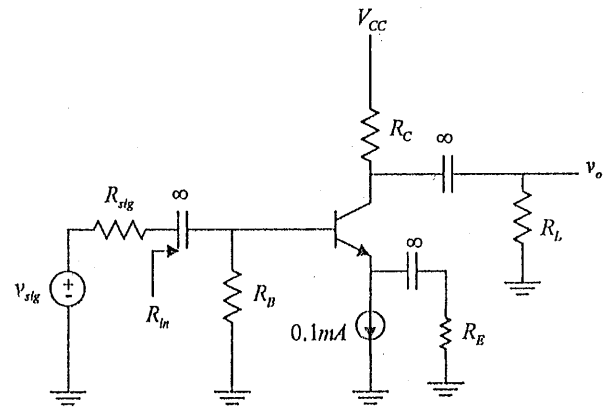


Fig. P4

3 Refer to Fig. P3, nMOS $V_t = 1$ Volt, $\mu_n C_{ox} (W/L)_n = 2 \text{ mA/V}^2$, $\lambda = 0.01 \text{ V}^{-1}$, $R_{sig} = 100 \text{ K}\Omega$,

$R_1 = 10 \text{ M}\Omega$, $R_2 = 5 \text{ M}\Omega$, $R_D = 7.5 \text{ K}\Omega$, $R_S = 3 \text{ K}\Omega$, $R_L = 10 \text{ K}\Omega$, $V_{DD} = 15 \text{ V}$.

(a) Calculate the dc current I_D (10%), find g_m and r_o (6%).

(b) Draw the small-signal equivalent circuit for the amplifier assuming all capacitors as short circuits at signal frequencies. (5%)

(c) Calculate R_{in} , $\frac{v_{gs}}{v_{sig}}$, $\frac{v_o}{v_{gs}}$ and $\frac{v_o}{v_{sig}}$. (16%)

4 Refer to Fig. P4, BJT $\beta = 100$, $R_{sig} = R_C = R_L = 20 \text{ K}\Omega$, $R_B = 1 \text{ M}\Omega$, $R_E = 250 \Omega$, $V_{CC} = 9 \text{ V}$

(a) Draw the small-signal equivalent circuit for the amplifier assuming all capacitors as short circuits at signal frequencies. (5%)

(b) Calculate R_{in} (6%), small-signal voltage gain $A_v = \frac{v_o}{v_{sig}}$ (15%).