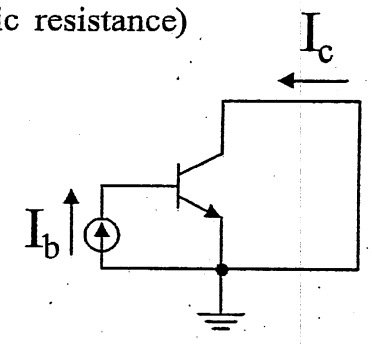
大同大學 97 學年度轉學入學考試試題

考試科目： 電子學　　所別:電機工程學系　　

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. Draw the high frequency model for the BJT (neglect r_x : base parasitic resistance) (derivation is necessary)



(a). Derive the current gain transfer function $A(s) = I_c / I_b$ (8%), define the 3dB frequency (ω_β), unity gain frequency (ω_T) and zero frequency(ω_z) in terms of BJT parameters (6%).

(b). Sketch the Bode plot $|A(j\omega)|_{dB}$ vs ω (log scale), and indicate ω_T, ω_β and ω_z.(6%)

2. (a) Sketch the small-signal equivalent circuit.(3%) (refer to Fig. P2)
(b) Derive the output resistance R_o in terms of MOS parameter and R_S. (11%)

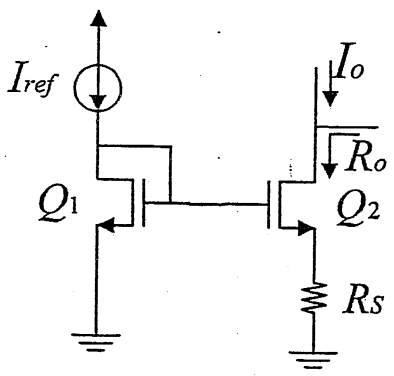


Fig. P2

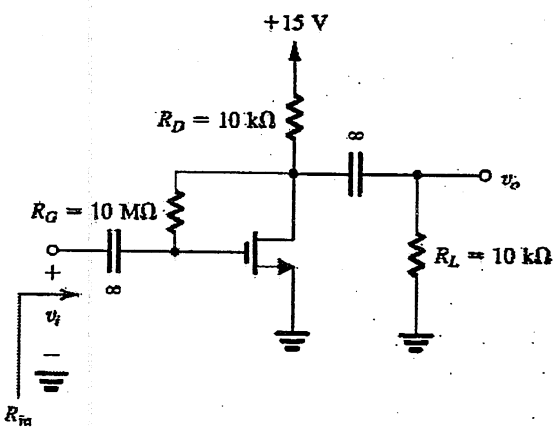


Fig. P3

3. Refer to Fig. P3, nMOS, $V_{tn} = 1.5\,V$, $k'_n W/L = \mu_n C_{ox} W/L = 0.25\,mA/V^2$, $V_A = 50V(=\frac{1}{\lambda})$

(a). Draw the DC equivalent circuit, calculate DC current I_D. (Neglect channel length modulation for DC calculation.)(9%)

(b). Draw the small-signal equivalent circuit. (3%). Calculate voltage gain $A_v = \frac{v_o}{v_i}$ (9%) and R_{in} (5,%) .

4. (a). Define $v_{id} = v_{B1} - v_{B2}$, $V_T = kT/q$, derive the collect currents i_{C1} and i_{C2} in terms of v_{id}, V_T and bias current I ...etc.. (10%) (Derivation is necessary.) (Fig. P4)

(b). Given $v_{B1} = 0.5\,v_{id}$, $v_{B2} = -0.5\,v_{id}$, $v_{id} << 2\,V_T$, I=1mA, BJT β=100, R_C=10kΩ, define $v_o = v_{C2} - v_{C1}$, calculate the small signal differential voltage gain v_o / v_{id}.(10%)

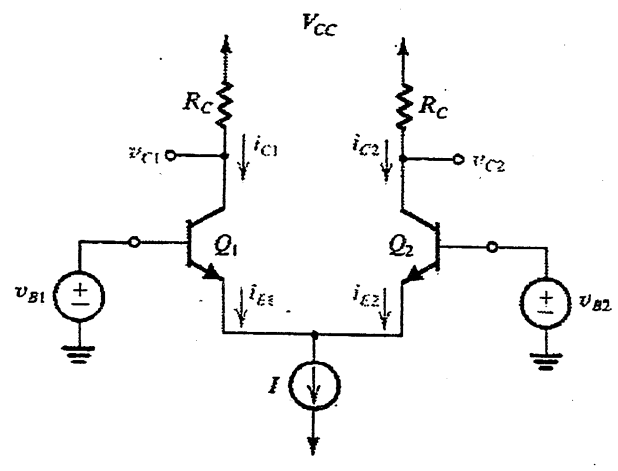


Fig. P4

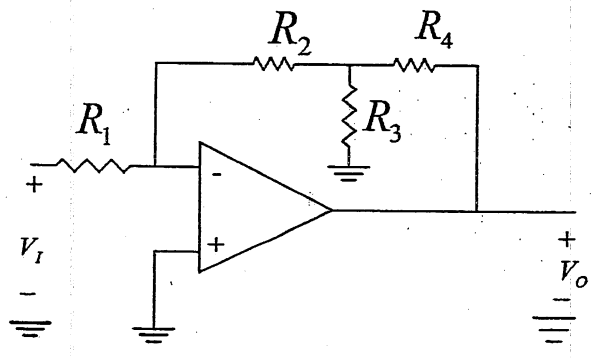


Fig. P5 (ideal OP)

5. Derive the transfer function $\frac{V_O}{V_I}$ for the Fig. P5. (20%)