國立臺灣科技大學
九十四學年度碩士班招生考試試題
系所組別：電子工程系碩士班丙組
科　　目：電子學

1. (15%)For the circuit shown in Fig. 1
   (a) Deduce the output voltage v_o in terms of input voltages $v_a, v_b ... v_3$. Assume the used OPAMP is ideal.
   (b) What's the function of resistor Rx, if the used OPAMP is not ideal.

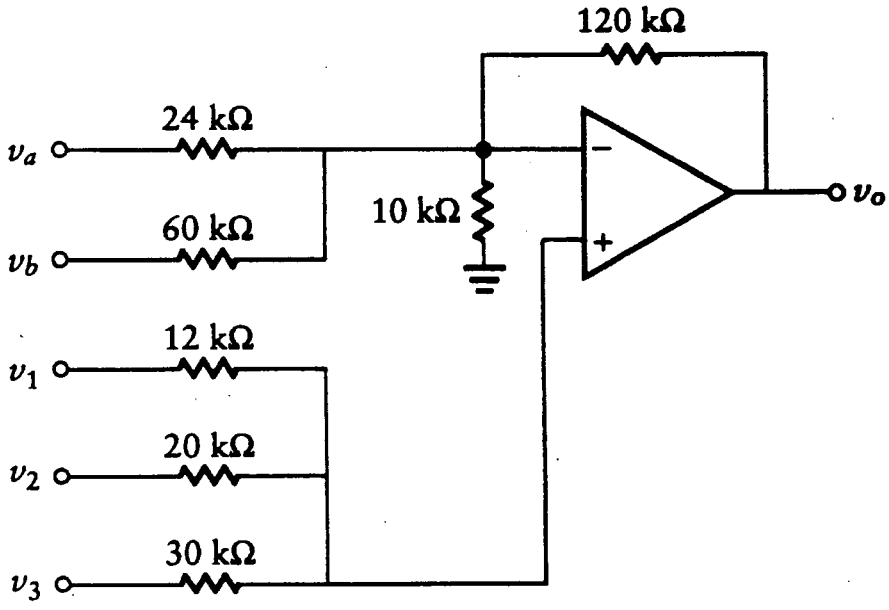


Fig. 1

2. (20%)Refer to the circuit in Fig 2 where the output resistance of current source I is R_{SS},
   (a) Let the two drain resistors be denoted R_{D1} and R_{D2} where $R_{D1} = R_D + \Delta R_D/2$ and $R_{D2} = R_D - \Delta R_D/2$ ($\Delta R_D \ll R_D$). Also let $g_{m1} = g_m + \Delta g_m/2$ and $g_{m2} = g_m - \Delta g_m/2$ ($\Delta g_m \ll g_m$) where g_{m1} and g_{m2} are the transconductances of Q_1 and Q_2 respectively. Please find the CMRR of the circuit in Fig 2.
   (b) If the bias current I is increased with R_{SS}, $\Delta g_m / g_m$, $\Delta R_D / R_D$ and other circuit parameters unchanged, will the CMRR be increased, decreased, or kept the same? Deduce or explain your answer.

109

國立臺灣科技大學
九十四學年度碩士班招生考試試題
系所組別：電子工程系碩士班丙組
科　　目：電子學

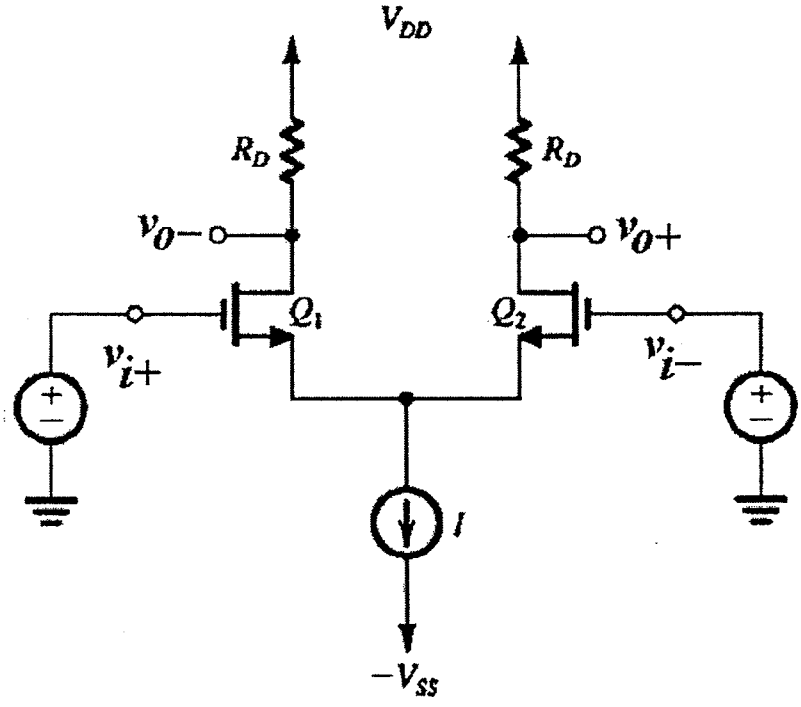


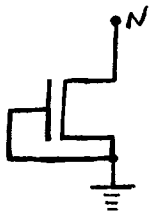
Fig. 2

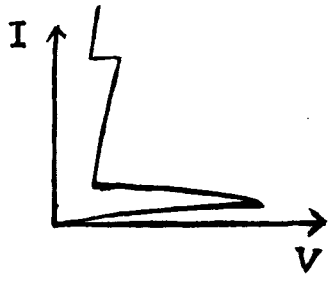
3. (15%) Consider a feedback amplifier for which the open-loop gain is given by $A(s)=\left(\frac{10}{1+s/10^4}\right)^3$. Let the feedback factor β is independent of frequency. Find the frequency ω_{180} at which the phase shift is 180°. Then, find the critical value β_{cr} at which the feedback amplifier will become unstable if $\beta>\beta_{cr}$.

110

國立臺灣科技大學
九十四學年度碩士班招生考試試題
系所組別：電子工程系碩士班丙組
科　　目：電子學

(4) For the ground-gate n-MOSFET shown below, a typical I-V curve also shown below is obtained while we current stressing it at node N. Please explain the results. (10%)





(5) For a typical n-MOSFET at a given drain bias, please plot the substrate current as a function of gate voltage, and explain why? (10%)

(6) Please sketch the electrical conductivity as a function of temperature (in K) for a Si material boron-doped with $1\times10^{16}cm^{-3}$. (10%)

(7) By using the Uncertainty Principle, please estimate the radius of hydrogen atom. (10%)

(8) Please sketch a typical forward I-V curve (I in log scale) for a Si pn junction diode, and explain why? (10%)

111