Home Assignment

Roll no → 190108022

① ⓐ −ve feedback

Voltage sampling → Current mixing

or Shunt sampling → shunt mixing

ⓑ There is a Shunt connection at the output so output resistance ↓ by $(1+A\beta)$

closed loop Rout = $\dfrac{\text{Open loop Rout}}{1+A\beta}$

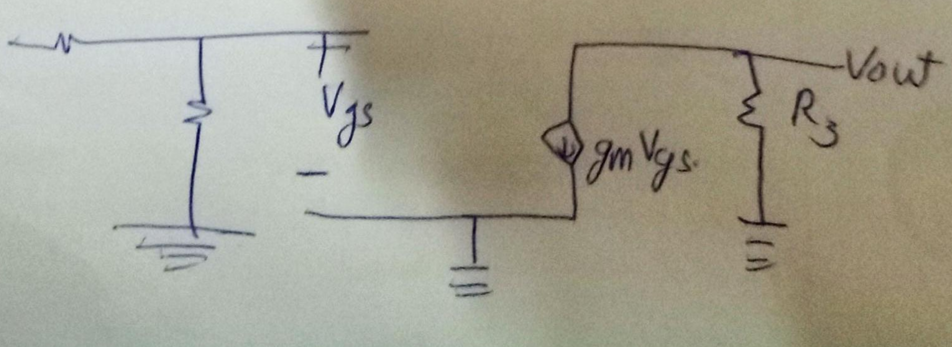
There is a shunt connection at i/p so i/p resistance ↓ by a factor $1+A\beta$

CL ~~to~~ Rin = $\dfrac{\text{OL Rin}}{1+A\beta}$

ⓒ At very high freq

small signal eqivalu

As capacitor get short ckt at High freq



$$V_{gs} = \frac{V_{in} \times R_2}{R_1 + R_2} \quad \text{— (1)}$$

Applying KCL

$$g_m V_{gs} + \left(\frac{V_{out} - 0}{R_3}\right) = 0$$

$$g_m V_{gs} = -\frac{V_{out}}{R_3}$$

we get $g_m \left(\frac{V_{in} R_2}{R_1 + R_2}\right) = \frac{-V_o}{R_3}$

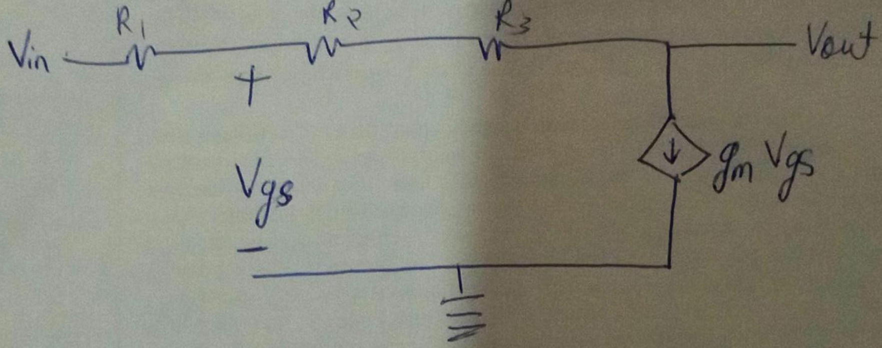
$$CL\ A = \frac{V_{out}}{V_{in}} = \frac{-120 \times 10^{-3}}{2} = -0.06$$

CL gain at High frequency

$$A = -0.06$$

At very small/low freq.

Small signal equivalent



KCL at output node:

$$\frac{V_{in} - V_{out}}{R_1 + R_2 + R_3} = g_m V_{gs} \quad \text{---} \; (1)$$

As same current $g_m V_{gs}$ flows through R_1

$$\Rightarrow \frac{V_{in} - V_{gs}}{R_1} = g_m V_{gs}$$

$$V_{in} = (1 + R_1 g_m) V_{gs}$$

$$V_{gs} = \frac{V_{in}}{1 + g_m R_1} \quad (2)$$

from (1) & (2)

$$\frac{V_{out}}{V_{in}} = 1 - \frac{(R_1 + R_2 + R_3)\, g_m}{1 + g_m (R_1)}$$

$$= 1 - 0.36 \qquad = 0.628$$

CL gain at low freq

$A = 0.628$

2 ⓐ negative feedback
voltage sampling → Voltage mixing
shunt sampling → seriesmixing
ⓑ As feedback ckt is connected in shunt with the o/p. The Rout for a closed loop ckt ↓ by a factor of $(1+A\beta)$ → feedback factor
↳ open loop gain

$$\text{closed loop } R_{out} = \frac{\text{open loop } R_{out}}{1+A\beta}$$

As the feedback is connected in series with the input. The i/p resistance for closed loop ckt ↑ by factor of $(1+A\beta)$

$$\text{closed loop } R_{in} = (\text{open loop } R_{in})(1+A\beta)$$

Open loop output impedance

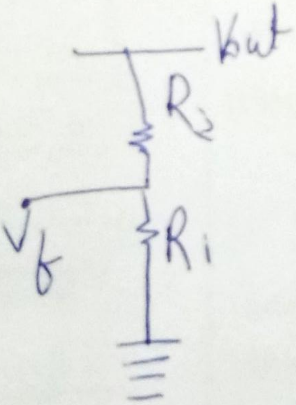
as; $\lambda = 0$ we can neglect r_{ds_2} & r_{ds_4}

There fore open loop $R_{out} = R_1 + R_2$

OL $\boxed{R_{out} = 2K\Omega}$

Therefore Gain closed loop can be given by

$$A_V = \frac{A_0}{1 + A_0 \beta}$$



feedback factor

$$\beta = V_f / V_{out} = \frac{R_1}{R_1 + R_2}$$

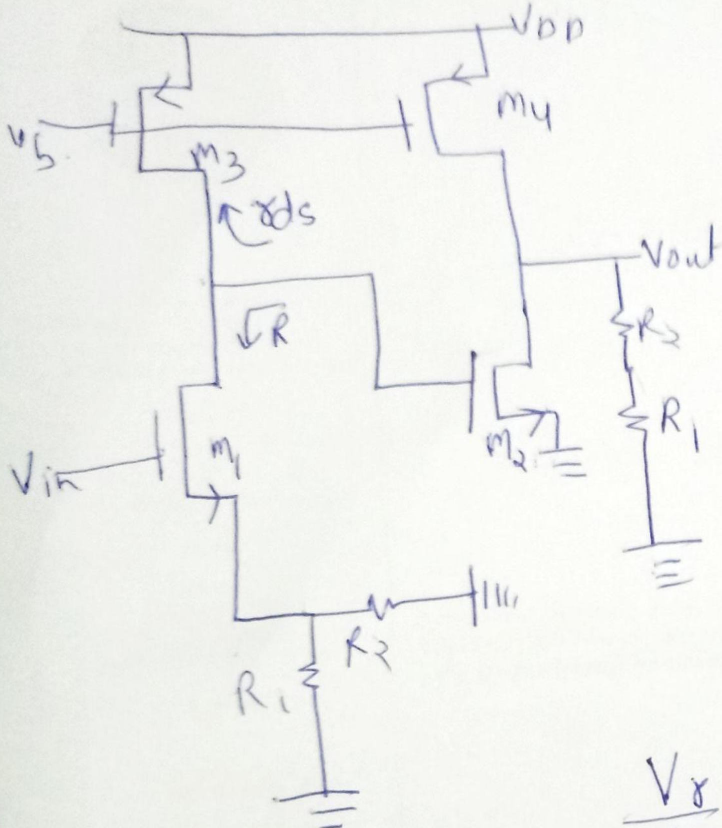
$$\boxed{\beta = \frac{1}{2}}$$

As $A_0 = \infty$ $\quad A_V = \frac{1}{\beta} = 2$

there-fore closed loop gain.

$CL = A_V = 2.$

(c) Open loop circuit



open loop gain $= \dfrac{V_{out}}{V_{in}}$

V_{out} # for first stage

$$\text{gain} = \frac{V_x}{V_{in}} = -g_{m_1}(r_{ds_3} \| R)$$

where $= R = (R_1 \| R_2) + r_{ds_1} + g_{m_1} r_{ds_1} (R_1 \| R_2)$

As $\lambda = 0 \Rightarrow r_{ds_1} = r_{ds_3} = \infty$

Therefore $r_{ds_3} \| R = \infty$

$$\frac{V_x}{V_{in}} = \infty \quad \text{— (1)}$$

for second stage; Gain $= \dfrac{V_{out}}{V_x} = -g_{m_2}(R_1 + R_2)$

$$\therefore \frac{V_{out}}{V_{in}} = \left(\frac{V_x}{V_{in}}\right)\left(\frac{V_{out}}{V_x}\right) = \infty\left(-g_{m_2}(R_1 + R_2)\right) = \infty$$

Therefore openloop Gain $= \infty$

or $A_0 = \infty$ — (2)

closed loop output impedance

as discussed in part B

$$CL\ R_{out} = \frac{OL\ R_{out}}{1 + A_o \beta}$$

as $A_o \approx \infty$ (open loop Gain)

$$\text{Closed loop } R_{out} = \frac{2K\Omega}{1+\infty \times \frac{1}{2}} = 0$$

Therefore closed loop $R_{out} = 0$

$CL \Rightarrow R_{out} = 0$