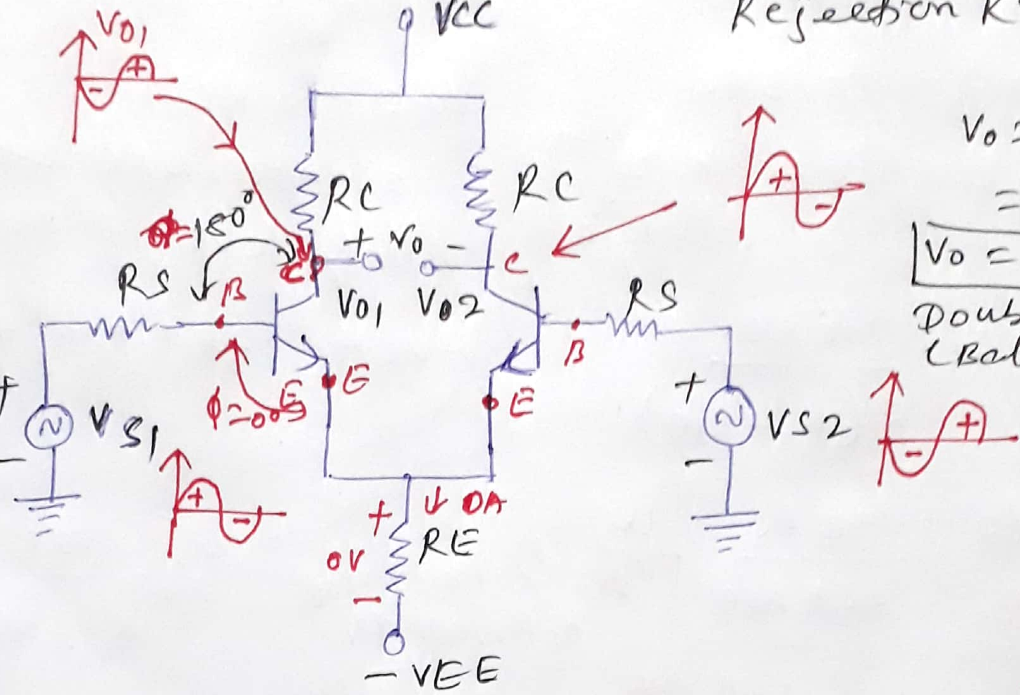
AC Analysis (that is Amplifier Analysis)

[Calculation of CMRR (common mode Rejection Ratio)]



$V_o = V_{o1} - V_{o2}$

$= V_{o1} - (-V_{o1})$

$\boxed{V_o = 2V_{o1}}$

Double o/p (Balanced o/p)

fig (differential Ampr)

$A_d = \frac{V_O}{V_S}$

AC analysis is have two modes:-

$CMMR = \left|\frac{A_d}{A_C}\right| = \int$

$\phi = 180°$

$V_d = V_{s1} - V_{s2} = \frac{V_S}{2} - \left(-\frac{V_S}{2}\right) = V_S$

$V_C = \frac{V_{s1} + V_{s2}}{2} = \frac{V_S + V_S}{2} = V_S$

where,

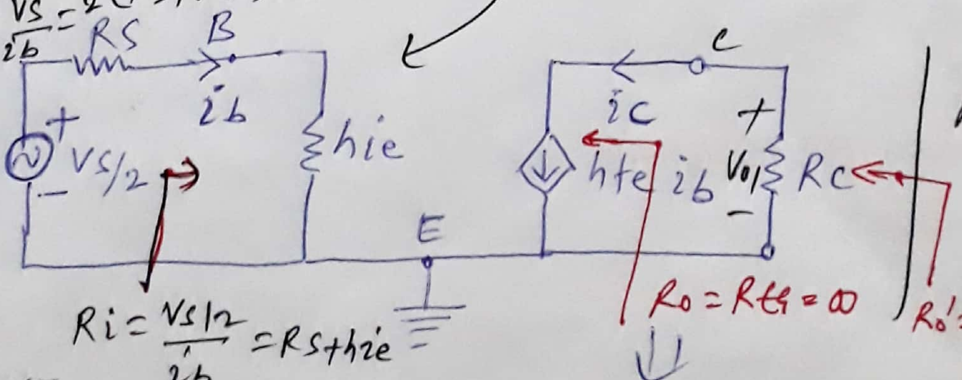
$|A_d|$ = magnitude of Diff. mode gain

$|A_C|$ = " " common mode gain

$A_C = \frac{V_{o1}}{V_S}$

Hybride model of diff. Ampr :- (1st part)

$R_i[D.Ampr] = \frac{V_S}{i_b} = 2(R_S + h_{ie})$



$R_i = \frac{V_S/2}{i_b} = R_S + h_{ie}$

$R_o = R_{th} = \infty$

$R_o' = \infty || R_C = R_C$

R_i = Enter Resistance

$$A_d = \frac{V_o}{V_s} = \frac{2V_{o1}}{V_s}$$

$V_{o1} = -i_c R_C$

$V_{o1} = -h_{fe} i_b R_C$

$$V_{o1} = -h_{fe} R_C \left[\frac{V_s/2}{R_s + h_{ie}}\right]$$

$$\frac{V_{o1}}{V_s} = \frac{-h_{fe} R_C}{2(R_s + h_{ie})}$$

$$\therefore \boxed{A_d = -\frac{h_{fe} R_C}{R_s + h_{ie}}}$$ Ans. (1) In form of h-Parameter

Differential gain Ans.

$$\boxed{A_d = \frac{-\beta R_C}{R_s + r_\pi}}$$ (2) In form of re model. Ans.

if $R_s << r_\pi$, then

$$\boxed{A_d = \frac{-\beta R_C}{r_\pi} = -g_m R_C}$$ Ans.

$V_o = V_{o1} - V_{o2}$

$V_o = 0$

In common mode gain,

Balance o/p = 0

Unbalanced o/p or single o/p, V_{o1}.

Common mode Gain :-

$$A_C = \frac{V_{o1}}{V_s}$$

$V_{o1} = -i_c R_C$

$= -h_{fe} i_b R_C$

Apply KVL, then

$-V_s + R_s i_b + h_{ie} i_b + 2R_E (1+\beta) i_b = 0$

$$i_b = \frac{V_s}{R_s + h_{ie} + 2R_E(1+\beta)}$$

$$A_C = \frac{V_{o1}}{V_s} = \frac{-h_{fe} R_C}{R_s + h_{ie} + 2R_E(1+\beta)}$$

$$= \frac{-\beta R_C}{R_s + r_\pi + 2R_E(1+\beta)}$$

$$\rho = \left|\frac{A_d}{A_c}\right| = \frac{R_s + h_{ie} + 2R_E(1+\beta)}{R_s + r_\pi}$$

$$\rho = \frac{R_s + r_\pi + 2R_E(1+\beta)}{R_s + r_\pi}$$

if $R_s << r_\pi$,

$$\rho = \frac{r_\pi + 2R_E(1+\beta)}{r_\pi}$$

V.V.I

RE	Ad	AC	ρ
↑	NC	↓	↑
↓	NC	↑	↓

NC → No change.

$$\rho = \frac{R_E}{r_e}$$

V.V.I.

$$g_m = \frac{I_C}{V_T}$$