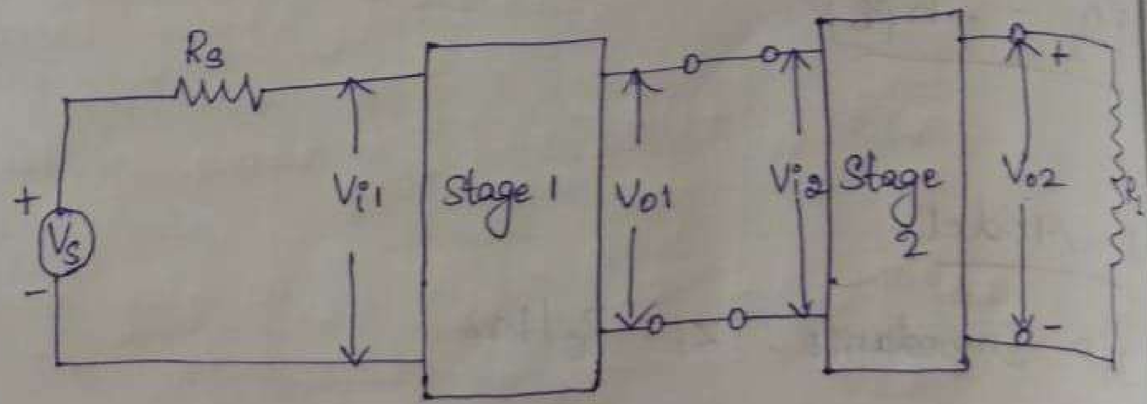
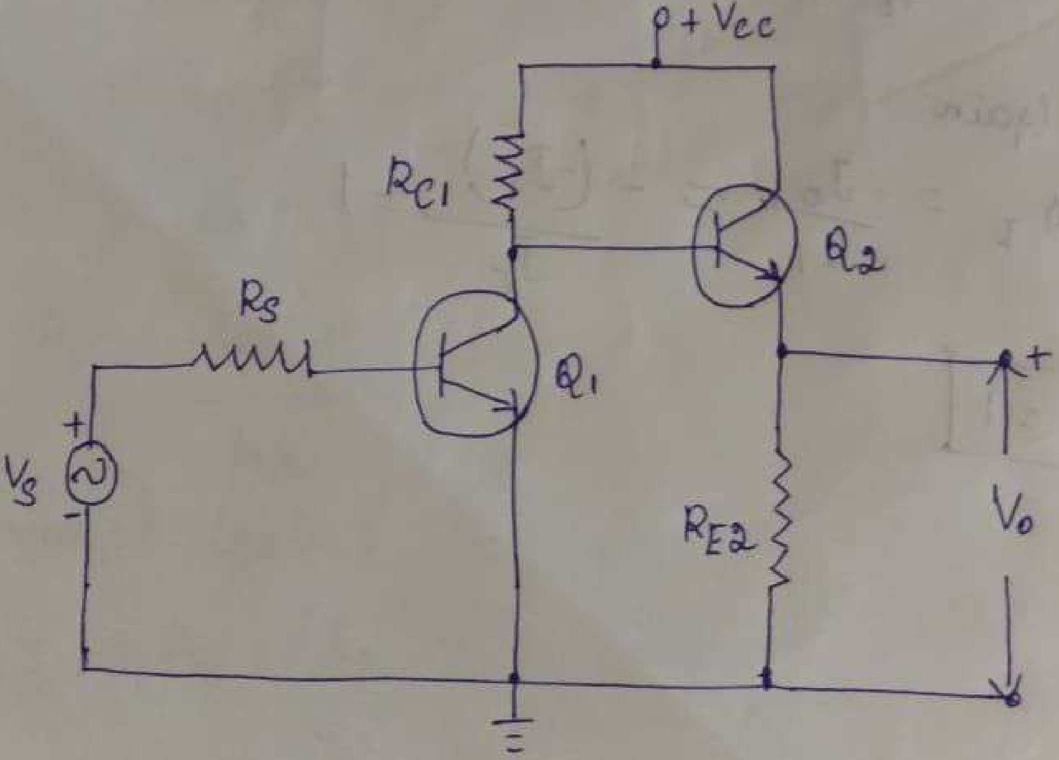
Two Stage Cascaded Amplifier :

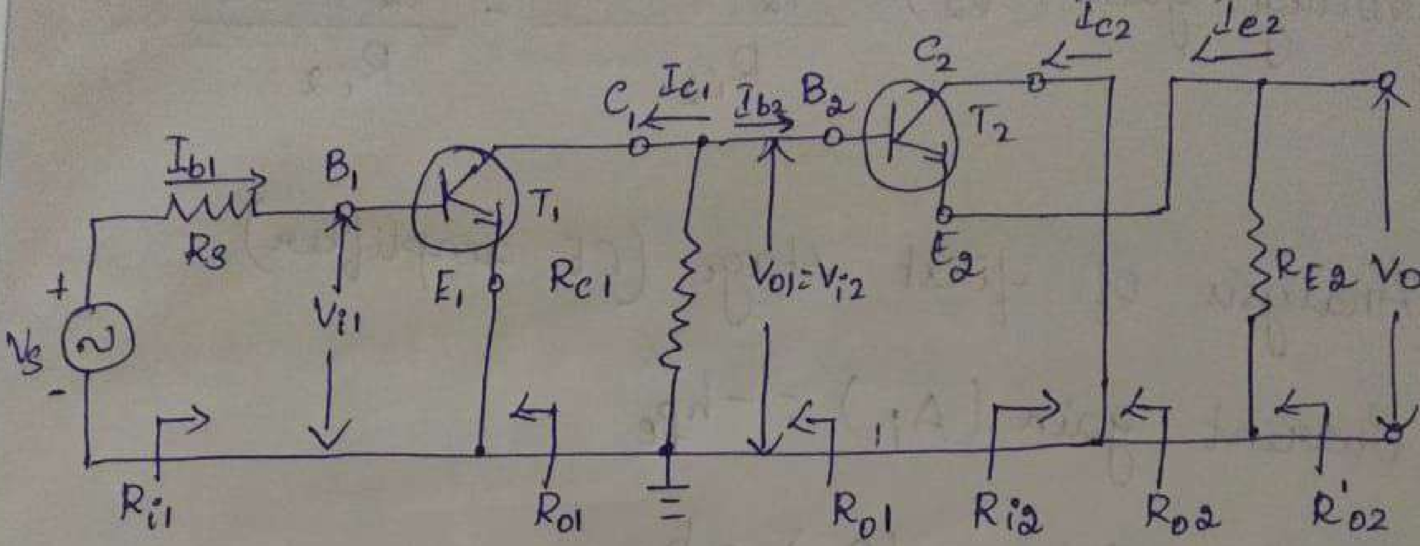


$$A_v = \frac{V_{o2}}{V_{i1}} = \frac{V_{o2}}{V_{i2}} \frac{V_{i2}}{V_{i1}}$$

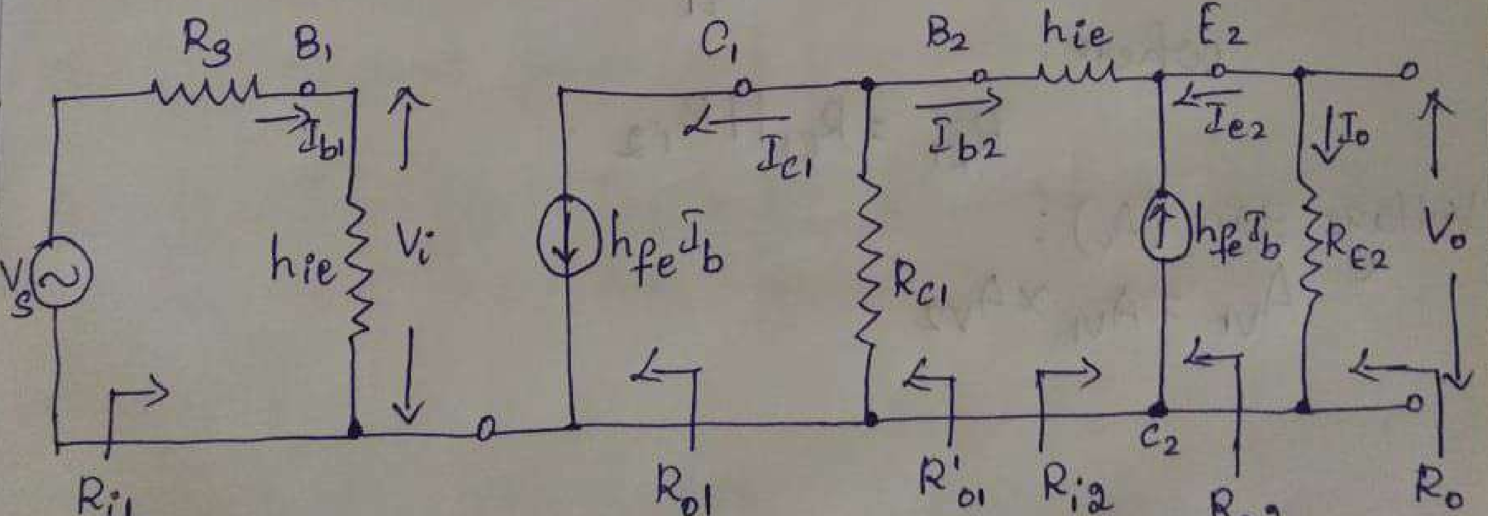
$$V_{o1} = V_{i2}$$

$$A_v = \frac{V_{o2}}{V_{i2}} \frac{V_{o1}}{V_{i1}} = A_{V2} A_{V1} .$$





Ib1
B1
Rs
+
Vs
-
Vi1
T1
E1
RC1
C1
IC1
Ib2
B2
C2
T2
E2
Vo1=Vi2
IC2
Ie2
RE2
Vo
Ri1
Ro1
Ro1
Ri2
Ro2
R'o2



Rs
B1
Ib1
Vs
hie
Vi
C1
IC1
hfe Ib
B2
Ib2
hie
E2
Ie2
RC1
hfe Ib
Io
RE2
Vo
C2
Ri1
Ro1
R'o1
Ri2
Ro2
Ro

Analysis of Second stage (CC amplifier):

Current gain $(A_{i2}) = 1 + h_{fe}$.

Input resistance $(R_{i2}) = h_{ie} + (1+h_{fe}) R_{E2}$.

Voltage gain $(A_{V2}) = \frac{A_{i2} \times R_{L2}}{R_{i2}} = \frac{A_{i2} \times R_{E2}}{R_{i2}}$

Analysis of first stage (CE amplifier):

Current gain $(A_{i1}) = -h_{fe}$

Input resistance $(R_{i1}) = h_{ie}$.

Voltage gain $(A_{V1}) = \frac{A_{i1} \times R_{L1}}{R_{i1}}$

where,

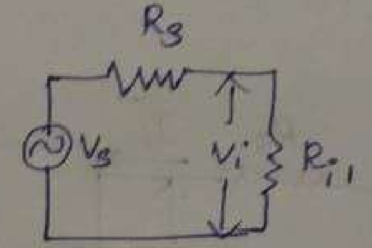
$$R_{L1} = R_{C1} || R_{i2}.$$

Voltage gain (A_V):

$$A_V = A_{V1} \times A_{V2}.$$

Overall voltage gain $(A_{vs}) = \frac{V_o}{V_s} = \frac{V_o}{V_i} \times \frac{V_i}{V_s}$

$$V_i = V_s \times \frac{R_{i1}}{R_s + R_{i1}}$$



$$A_{vs} = \frac{V_o}{V_i} \times \frac{R_{i1}}{R_s + R_{i1}}$$

$$= A_v \times \frac{R_{i1}}{R_s + R_{i1}}$$

Output resistance (R_o) : -

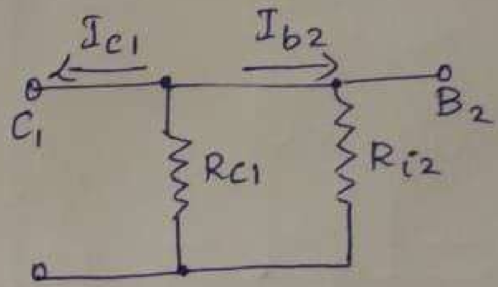
$$R'_{01} = R_{01} \,||\, R_{C1}$$

$$R_{02} = \frac{R_s + h_{ie}}{1 + h_{fe}} = \frac{R'_{01} + h_{ie}}{1 + h_{fe}}$$

$$R_o = R_{02} \,||\, R_{E2}$$

Overall current gain (A_i) :

$$A_i = \frac{I_o}{I_{b1}} = \frac{I_o}{I_{e2}} \times \frac{I_{e2}}{I_{b2}} \times \frac{I_{b2}}{I_{c1}} \times \frac{I_{c1}}{I_{b1}}$$



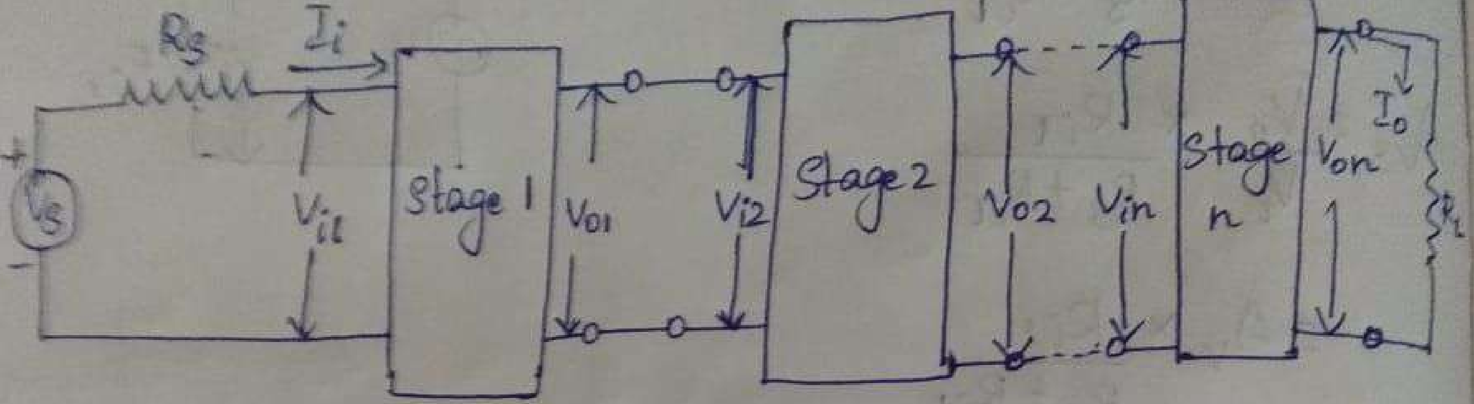
where,

$$\frac{I_o}{I_{e2}} = -1 \quad , \frac{I_{e2}}{I_{b2}} = -A_{i2}$$

$$\frac{I_{b2}}{I_{c1}} = -\frac{R_{c1}}{R_{i2} + R_{c1}}$$

$$\frac{I_{c1}}{I_{b1}} = A_{i1}$$

n-Stage Cascaded Amplifier :



$$A_v = A_{v1} + A_{v2} \dots A_{vn}.$$

The voltage gain of the k^{th} stage is,

$$A_{vk} = \frac{A_{ik} R_{Lk}}{R_{ik}}.$$