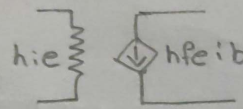
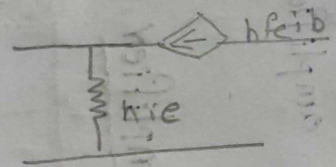
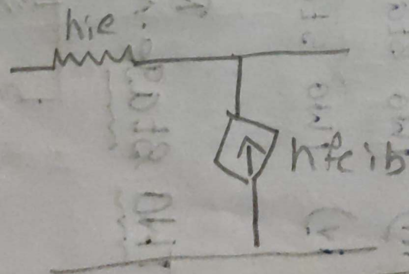
S.NO	Confriguation	H-parameter Equivalent	Parameters.
1.	CE confriguation		$R_i = h_{ie}$ $A_I = -h_{fe}$ $A_V = \frac{A_I \times R_L}{R_i}$. $R_o = \infty$.
2.	CB confriguation		$R_i = \frac{h_{ie}}{1+h_{fe}}$ $A_I = \frac{h_{fe}}{1+h_{fe}}$ $A_V = \frac{A_I R_L}{R_i}$; $R_o = \infty$.
3.	CC confriguation.		$R_i = h_{ie} + (1+h_{fe})R_L$ $A_I = 1+h_{fe}$ $A_V = \frac{A_I \times R_L'}{R_i}$; $R_o = \frac{R_S + h_{ie}}{1+h_{fe}}$.

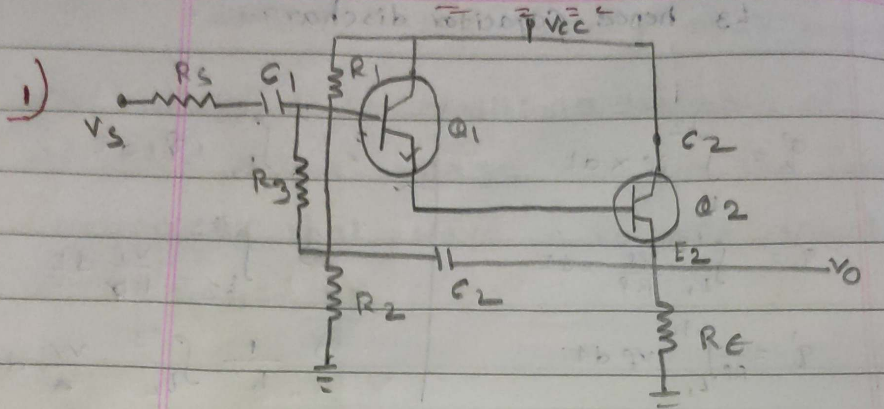
$\frac{-h_{fe}(R_C \| R_L)}{h_{ie}}$

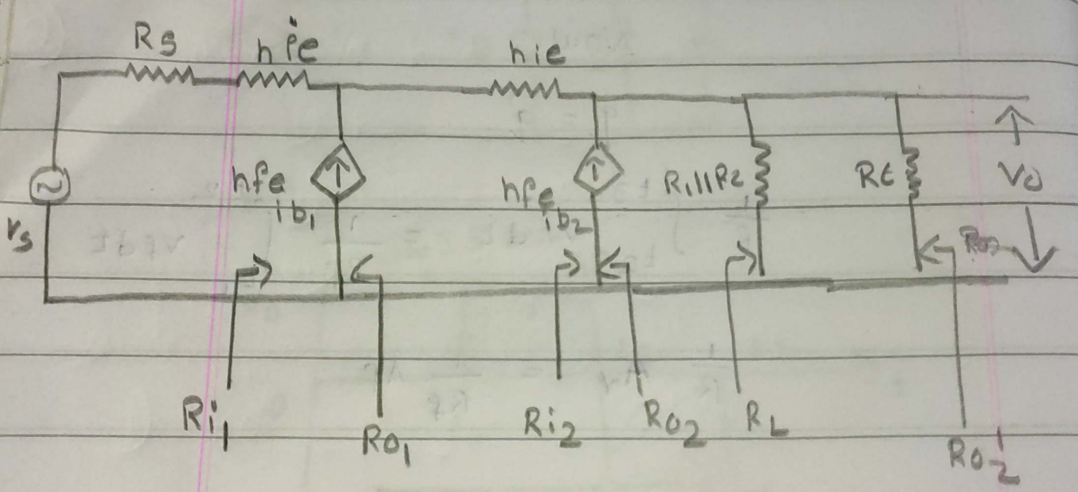
* Loading Effect :-
let us consider a two amplifier connected in cascade.

UNIT-2

5 MARKS

1)





Here Stage 1 is CC Amplifier
Stage 2 is CC Amplifier

> **Note :-** Before doing analysis pls verify the CC Amplifier table values.

Stage-2 :-

AI_2 =

RI_2 =

AV_2

Stage-2 :-

$$A_{I_2} = 1 + h_{fe}$$

$$R_{I_2} = h_{ie} + (1+h_{fe})R_L$$

$$= (1+h_{fe})R_L \quad (\because h_{ie} <<< (1+h_{fe})).$$

$$A_{V_2} = \frac{A_{I_2} \times R_L'}{R_{i_2}}$$

$$\Rightarrow \frac{(1+h_{fe})R_L}{(1+h_{fe})R_L} = 1.$$

$$R_{o_2} \Rightarrow \frac{R_s + h_{ie}}{1+h_{fe}} \Rightarrow \frac{h_{ie}}{1+h_{fe}}$$

$$R_{o_2}' \Rightarrow R_{o_2} \,||\, R_L \cong R_{o_2}.$$

Stage-1 :-

$$A_{I_1} = 1 + h_{fe}$$

$$R_{I_1} = h_{ie} + (1+h_{fe})R_L$$

$$\Rightarrow (1+h_{fe})R_L.$$

$$A_{V_1} \Rightarrow \frac{A_{I_1} \times R_L'}{R_{i_1}} \Rightarrow \frac{(1+h_{fe}) \times R_L}{(1+h_{fe})R_L} = 1$$

$$R_{o_1} \Rightarrow \frac{R_s + h_{ie}}{1+h_{fe}} \Rightarrow \frac{h_{ie}}{1+h_{fe}}$$

$$(\because R_s <<< \cancel{1+}\, h_{ie})$$

* **Loading Effect :-**

Let us consider a two amplifier connected in cascade.

Overall Analysis :-

$$A_I = (1+h_{fe})(1+h_{fe}) = (1+h_{fe})^2$$

$$R_I = \left[(1+h_{fe})R_L\right]\left[(1+h_{fe})R_L\right]$$

$$\Rightarrow (1+h_{fe})^2 R_L^2$$

$$A_V = 1 \times 1 = 1$$

$$R_o = \frac{h_{ie}}{1+h_{fe}} \times \frac{h_{ie}}{1+h_{fe}}$$

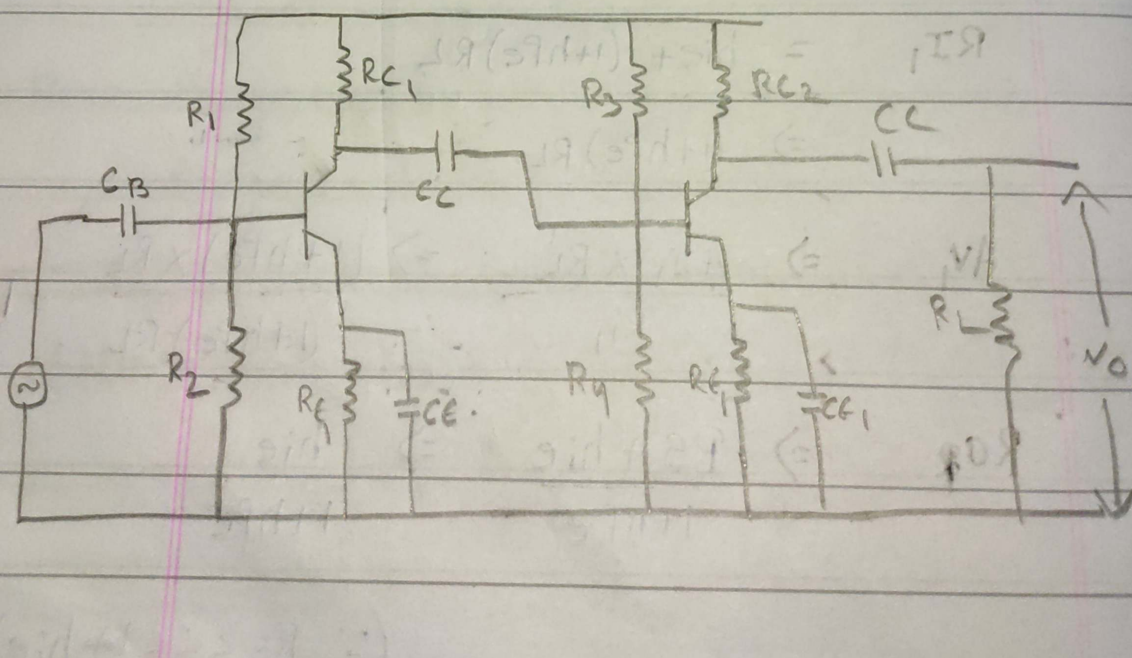
2) There are three types of coupling:-

i) RC coupling

ii) transformer coupling

iii) Direct coupling.

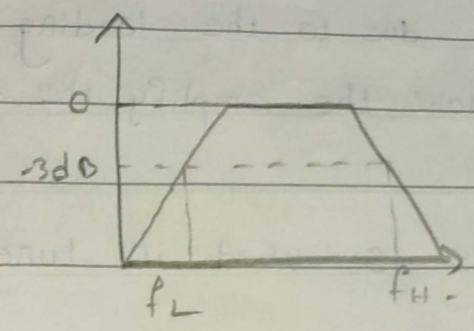
i) RC coupling :-



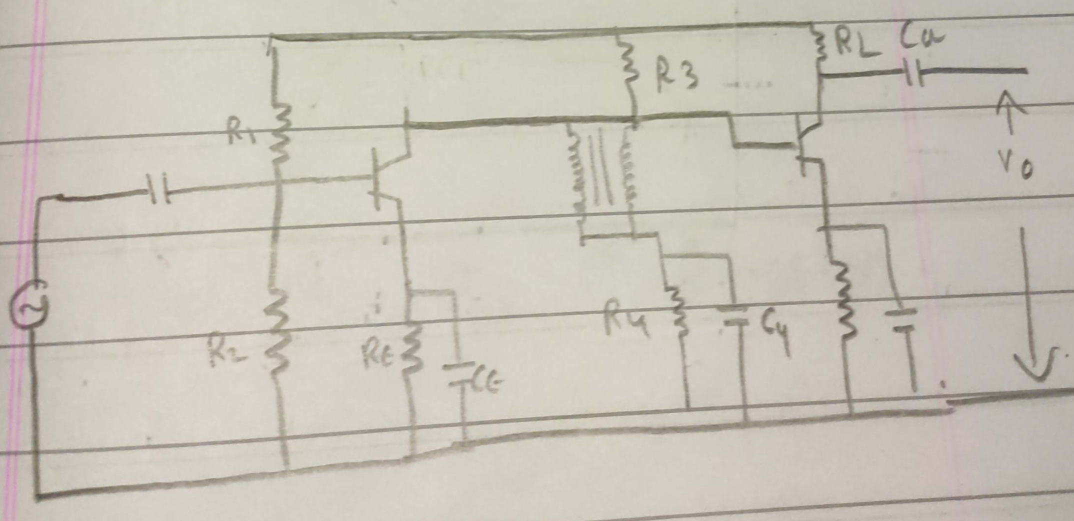
i) This RC coupling does not effect the Q-point of stage 2 because the coupling factor is blocks the first stage voltage

ii) Due to this blocking it will produce wide band frequency response. so they are used in complete audio amplifier frequency bands

iii) This total response will drops at low frequency because the coupling capacitor will drops the high frequency.



ii) Transformer coupling



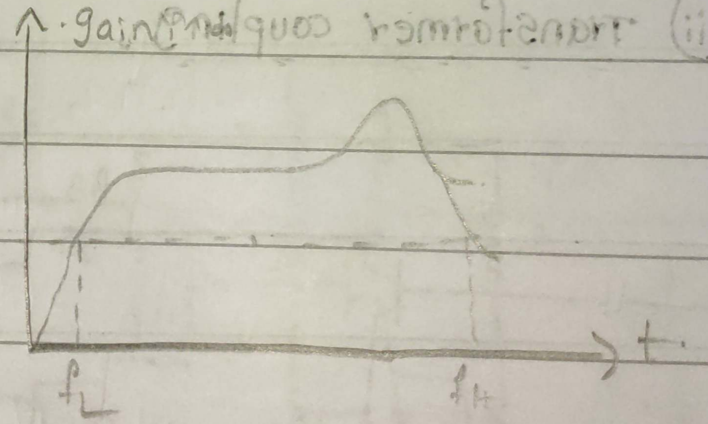
i) The output of first stage is coupled with the input of second stage through transformer is called transformer amplifier

ii) This type of coupling is used to match the impedance between the output of first stage and input of second stage.

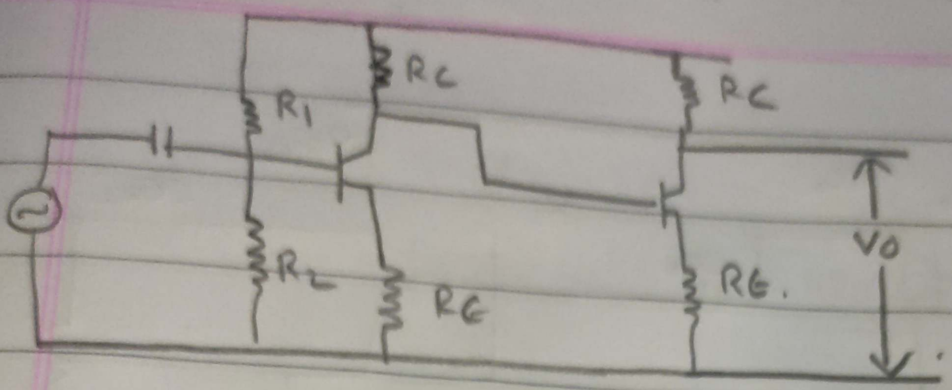
iii) This transformer coupling does not effect the Q-point of next stage amplifier.

iv) The frequency response of transformer coupling amplifier is low ~~be~~ when compared to the RC coupling due to the loading inductance does not allow the amplify the signal.

v) This amplifiers is used in tuned amplifiers

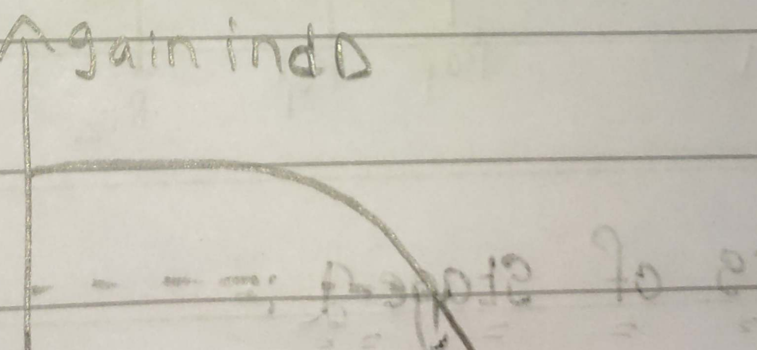


iii) Direct coupling:-



i) The output of first stage is directly coupled with the input of second stage.

ii) The direct coupling allows the dc collectors of first stage and pass through base of second stage. It will effect the biasing condition.



3 QUESTION

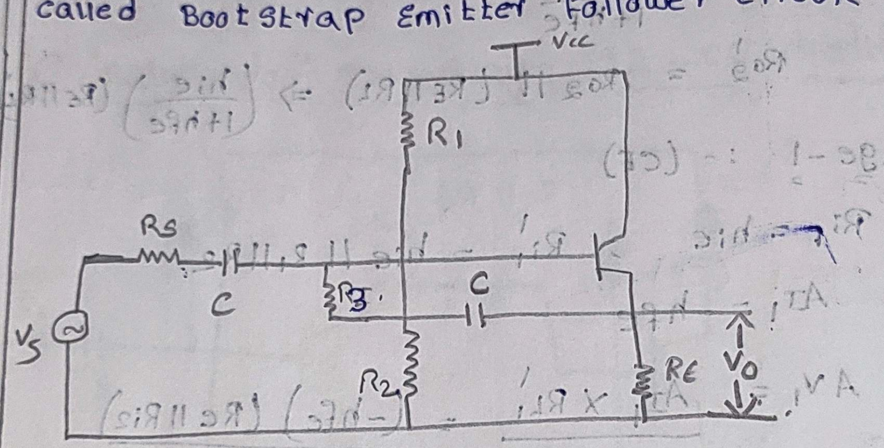
* Boot strap Emitter Follower:-

Generally in the Darlinton pair amplifier the resistence $R_i = R_{i1} = (1+h_{fe})(R_{o1} \| R_{i2})$

If we consider the biasing resistence then the resistence decreases because biasing resistance values less i.e

$$R_i = R_i' = R_{i1} \| (R_1 \| R_2).$$

Inorder to avoid that problem a technique is called Boot strap Emitter follower circuit



A circuit which include two components (A_3, c) to the cc Amplifier is known as Emitter follower circuit. The resistor R_3 is connected b/w base of transistor and combination of R_1 & R_2 and capacitor c is connected b/w emits of the transistor.

For DC signal capacitor doesn't allows and binary is provided of R_1, R_2, R_3.

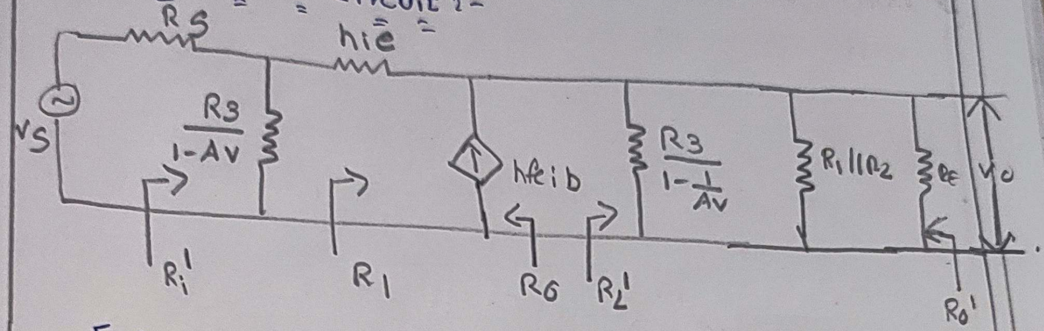
For AC signals the bottom of R_3 is connected the o/p and top of R_3 is conneckd to i/p.

Miller's theorem states the Impedence is connected b/w two nodes then it is representation by two components one is connected to i/p w.r.t ground another one is connected with o/p with respect ground.

$$\frac{Z}{1-A_V} \; ; \; \frac{Z}{1-\frac{1}{A_V}}$$

i.e $$\frac{R_3}{1-A_V} \; ; \; \frac{R_3}{1-\frac{1}{A_V}}.$$

AC equivalent circuit :-



For CC Amplifier the voltage gain is 1 which means circuit ie $\frac{R_3}{1-A_V} \; ; \; \frac{R_3}{1-\frac{1}{A_V}} \rightarrow \infty$ [O.C].

$$R_i = h_{ie} + (1+h_{fe}) R_L'$$

$$R_i = (1+h_{fe}) R_L'$$

$$R_i = (1+h_{fe}) (R_1 \| R_2 \| R_E).$$

$$R_o = \frac{h_{ie} + R_S}{(1+h_{fe})}$$

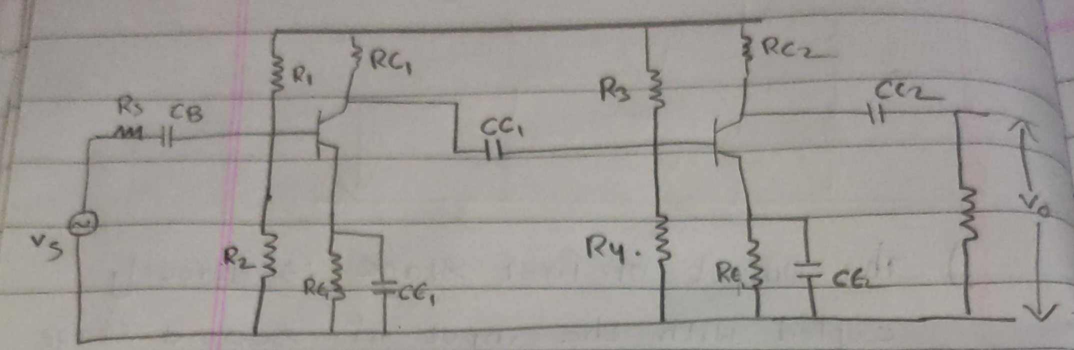
$$R_o' \Rightarrow R_o \| R_L' \Rightarrow R_o' \Rightarrow \frac{h_{ie}+R_S}{1+h_{fe}} \| (R_1 \| R_2 \| R_E)$$

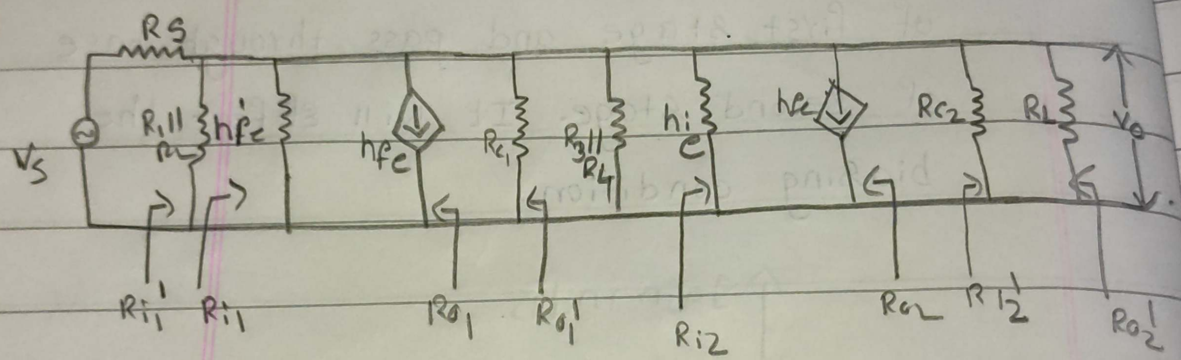
$$A_I \Rightarrow 1+h_{fe}$$

$$A_V \Rightarrow \frac{A_I \times R_L'}{R_i} = \frac{\cancel{(1+h_{fe})} \cancel{(R_1 \| R_2 \| R_E)}}{\cancel{(1+h_{fe})} \cancel{(R_1 \| R_2 \| R_E}} = 1$$

4) Same as the 1st Question.

5) TWO stage RC coupled Amplifier:-





Analysis of stage-2 :-

$Ri_2 = hie$

$AI_2 = -hfe$

$$AV_2 = \frac{AI_2 \times RL'}{Ri_2} \Rightarrow \frac{-hfe \times (RC_2 \parallel R_L)}{hie}.$$

$Ro_2 = \infty.$

$Ro_2' = \infty \parallel RC_2 \parallel R_L \Rightarrow RC_2 \parallel RL$

Analysis of stage-1 :-

$R_{i_1} = h_{ie}$

$A_{I_1} = -h_{fe}$

$R_{i_1}' = R_1 \| R_2 \| h_{fe}$.

$A_{V_1} = \dfrac{A_{I_1} \times R_L'}{R_{i_1}'} \Rightarrow \dfrac{-h_{fe}(R_{C_1} \| R_3 \| R_4 \| h_{ie})}{h_{ie}}$

$R_{O_1} = \infty$

$R_{O_1}' = \infty \| R_{C_1} = R_{C_1}$.

Overall Analysis :-

$R_I = R_{i_1}' = R_1 \| R_2 \| h_{ie}$.

$R_O = R_{O_2}' = R_{C_2} \| R_L$

$A_V = A_{V_1} \times A_{V_2}$

$\Rightarrow \left[\dfrac{-h_{fe}(R_{C_1} \| R_3 \| R_4 \| h_{ie})}{h_{ie}}\right] \left[\dfrac{-h_{fe}(R_{C_2} \| R_L)}{h_{ie}}\right]$

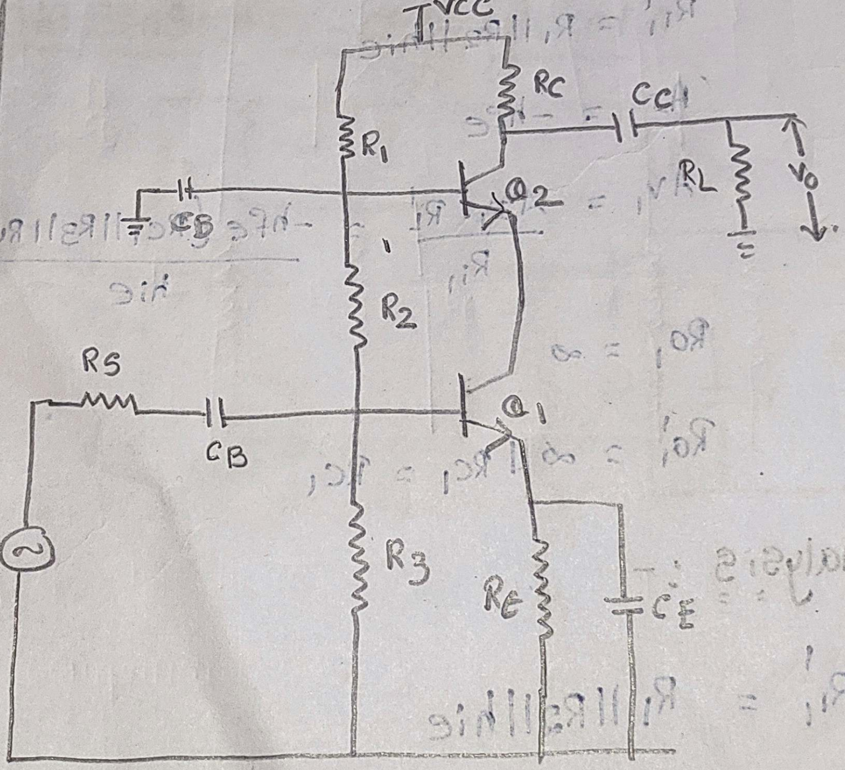
$A_I \Rightarrow -h_{fe} \times -h_{fe} = (h_{fe})^2$

6th QUESTION

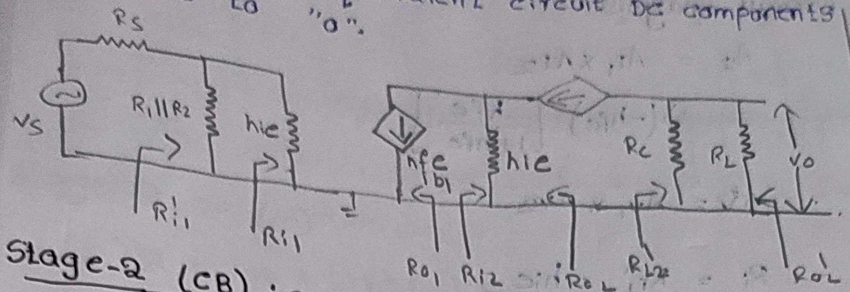
* TWO Stage CE-CB Amplifier (cascaded)

→ The cascading of CE-CB amplifier is also known as cascaded Amplifier.

→ which consists of CE amplifier series with CB amplifier.



To draw the AC equivalent circuit DC components are said to "0".



Stage-2 (CB) :-

$$R_{i2} = \frac{h_{ie}}{1+h_{fe}}$$

$$A_{I2} = \frac{h_{fe}}{1+h_{fe}}$$

$$A_{V2} = \frac{A_{I2} \times R_L'}{R_{i2}} = \frac{\left(\frac{h_{fe}}{1+h_{fe}}\right)(R_c \| R_L)}{\frac{h_{fe}}{1+h_{fe}}}$$

$$R_{o2} = \infty$$

$$R_{o2}' = \infty \| R_c \| R_L \Rightarrow R_c \| R_L.$$

Stage-1 (CE) :-

$$R_{i1} = h_{ie}$$

$$R_{i1}' = h_{ie} \| R_2 \| R_3$$

$$A_{I1} = -h_{fe}$$

$$A_{V1} = \frac{A_I \times R_L'}{R_{i1}} = \frac{(-h_{fe})(R_{i2})}{R_{i1}} \Rightarrow \frac{(-h_{fe})\left(\frac{h_{ie}}{1+h_{fe}}\right)}{h_{ie}}.$$

$$R_{o1} = \infty.$$

Overall Analysis :-

$$A_I = A_{I_1} \times A_{I_2}$$

$$\Rightarrow (-h_{fe}) \left[\frac{h_{fe}}{1+h_{fe}}\right]$$

$$A_V = A_{V_1} \times A_{V_2}$$

$$R_i = R_{i_1}' = h_{ie}$$

$$R_o = R_{o_2}' = R_C \| R_L$$

$$A_{VS} = \frac{A_V \cdot R_i'}{R_S + R_{i_1}'}$$

$$A_{IS} = \frac{A_I R_S}{R_S + R_{i_1}'}$$

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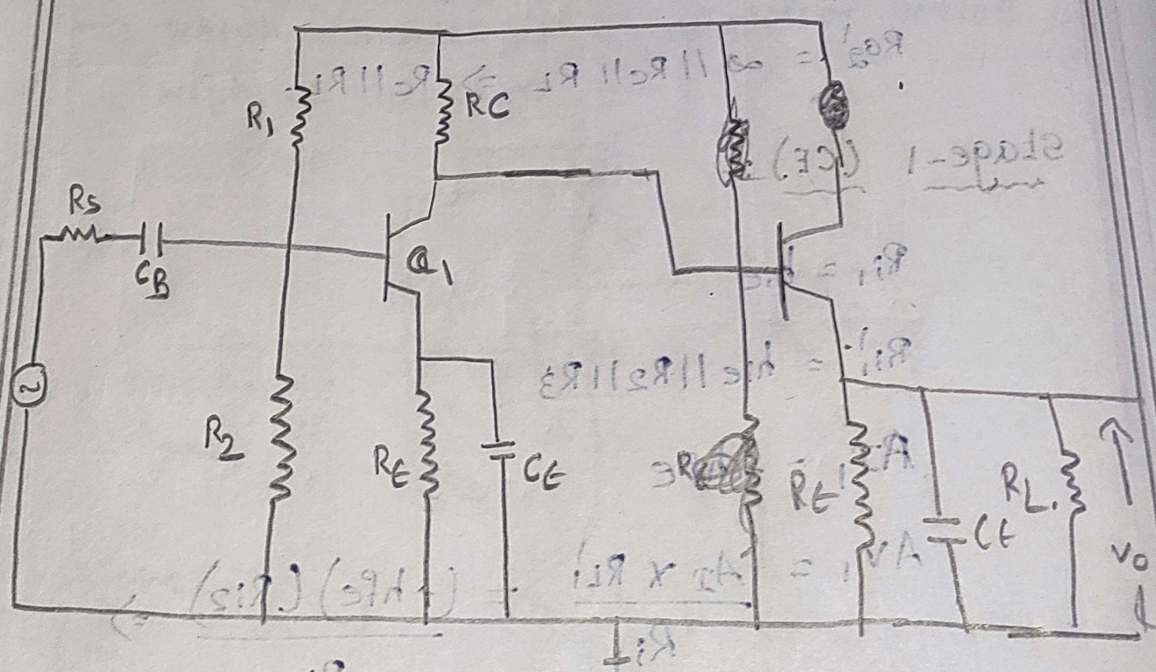
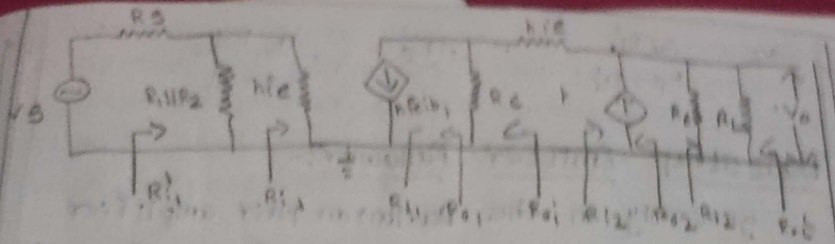
7 QUESTION

* AC Analysis of Two Stage CE - CC Amplifier :-



→ To draw AC equivalent circuit DC components are set to be zero.



Stage - 2 :- (cc)

$R_{i2} = h_{ie} + (1+h_{fe}) R_{L2}$

$\Rightarrow h_{ie} + (1+h_{fe}) (R_E \| R_L)$

$A_{I2} = 1 + h_{fe}$

$A_{V2} = \frac{A_{I2} \times R_{L2}'}{R_{i2}} \Rightarrow \frac{(1+h_{fe})(R_E \| R_L)}{h_{ie} + (1+h_{fe})(R_E \| R_L)}$

$R_{o2} = \frac{h_{ie}}{1+h_{fe}}$

$R_{o2}' = R_{o2} \| (R_E \| R_L) \Rightarrow \left(\frac{h_{ie}}{1+h_{fe}}\right) (R_E \| R_L)$

Stage - 1 :- (CE)

$R_{i1} = h_{ie}$; $R_{i1}' = h_{ie} \| R_1 \| R_2$

$A_{I1} = -h_{fe}$

$A_{V1} = \frac{A_{I1} \times R_{L1}'}{R_{i1}} = \frac{(-h_{fe})(R_C \| R_{i2})}{h_{ie}}$

$R_{o1} = \infty$

$R_{o1}' = \infty \| R_C = R_C$

Overall Analysis :-

$R_i = R_{i1}' = h_{ie} \| R_1 \| R_2$

$R_o = R_{o2}' = \left(\frac{h_{ie}}{1+h_{fe}}\right) (R_E \| R_C)$

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

$A_I = A_{I1} \times A_{I2} \Rightarrow (-h_{fe})(1+h_{fe})$

8) Given that

$h_{fe} = 100$ $R_S = 1K\Omega$.

$h_{ie} = 2K\Omega$ $R_E = 25K\Omega$.

$h_{re} = h_{oe} = 0$ $R_C = 100\Omega$.

Given that it is the cascode circuit

i.e CE-CB

$$A_I = [-h_{fe}]\left[\frac{h_{fe}}{1+h_{fe}}\right]$$

$$-100 \times \frac{100}{101} \Rightarrow -100 \times 0.99$$

$$\Rightarrow -99.$$

$$A_V = A_{V_1} \times A_{V_2}$$

$$\Rightarrow \left[\frac{(-h_{fe})\left(\frac{h_{ie}}{1+h_{fe}}\right)}{h_{ie}}\right] \times \left[\frac{\frac{h_{fe}}{1+h_{fe}}(R_C \| R_L)}{\frac{h_{fe}}{1+h_{fe}}}\right]$$

$$\Rightarrow \left[\frac{(-100)\left(\frac{2\times10^3}{101}\right)}{2\times10^3}\right]\left[\frac{100\times1000}{100+1000}\right]$$

$$\Rightarrow \left[\frac{-0.99\times\cancel{2\times10^3}}{\cancel{2\times10^3}}\right]\left[\frac{1000\cancel{00}}{11\cancel{00}}\right]$$

[0.99] [90

-90.

$A_{V_S} \Rightarrow$

[0.99] [90.90]

-90.

$$A_{VS} \Rightarrow \frac{A_V \times R_i'}{R_S + R_i'} \qquad \left[\text{From Analysis } R_i' = h_{ie}\right]$$

$$\Rightarrow \frac{A_V \times h_{ie}}{R_S + h_{ie}}$$

$$\Rightarrow \frac{-90 \times 2 \times 10^3}{1 \times 10^3 + 2 \times 10^3}$$

$$\Rightarrow \frac{-180 \times 10^3}{1000 + 2000} \Rightarrow \frac{-180 \times 10^3}{3000} \Rightarrow \frac{-180 \times \cancel{10^3}}{3 \times \cancel{10^3}}$$

$$\Rightarrow -60.$$

$$R_i \Rightarrow h_{ie} \Rightarrow 2k\Omega$$

$$\Rightarrow 2 \times 10^3$$

$$R_O \Rightarrow R_{O_2}' \Rightarrow R_C \parallel R_L$$

$$\Rightarrow \frac{100 \times 1000}{100 + 1000} \Rightarrow \underline{\underline{90.90}}.$$