$$= \frac{R_o' (1+\beta A_i')}{1+\beta A_i}$$

JS
~~5/06/17~~

26/6/4

Methodology of Feedback Amplifiers & analysis :-

i) → To analyse the feedback amplifier, it is necessary to go for following steps :-

Step 1 :- Identify ~~topology~~ topology i.e type of feedback.

(a) To find the type of sampling Network,

(i) By shorting the o/p $V_o = 0$, if feedback signal X_f becomes zero, then we can say that it is voltage sampling.

(ii) By opening the o/p loop, i.e current, $I_o = 0$, if feedback signal X_f becomes zero, then we can say that it is current sampling

(b) <u>To find the type of mixing n/wk:-</u>

(i) If the feedback signal is subtracted from the externally applied signal, as a voltage, in the i/p loop we can say that it is <u>series mixing</u>.

(ii) If the feedback signal is subtracted from the externally applied signal, as a current, in the i/p loop, we can say that is ~~ckt~~ <u>Shunt mixing</u>.

<u>Step 2</u>:- Find the i/p ckt,

(i) for <u>voltage sampling</u>, make $V_o = 0$ by shorting the o/p loop.

(ii) for <u>current sampling</u>, make $I_o = 0$, by opening the o/p loop; (or open ckting)

<u>Step 3</u>:- <u>Find the o/p ckt</u>,

(i) for series mixing make, $I_i = 0$ by opening the i/p loop

(ii) for shunt mixing make $V_i = 0$

by Shorting the i/p.

Step4:- Replace Each active device by its H-parameter model at low frequency.

Step5:- Find the open loop gain; i.e (without feedback) denoted as 'A' of Amplifier

Step6:- Indicate X_f and X_o on the Circuit & evaluate $\beta = \frac{V_f}{V_o}$.

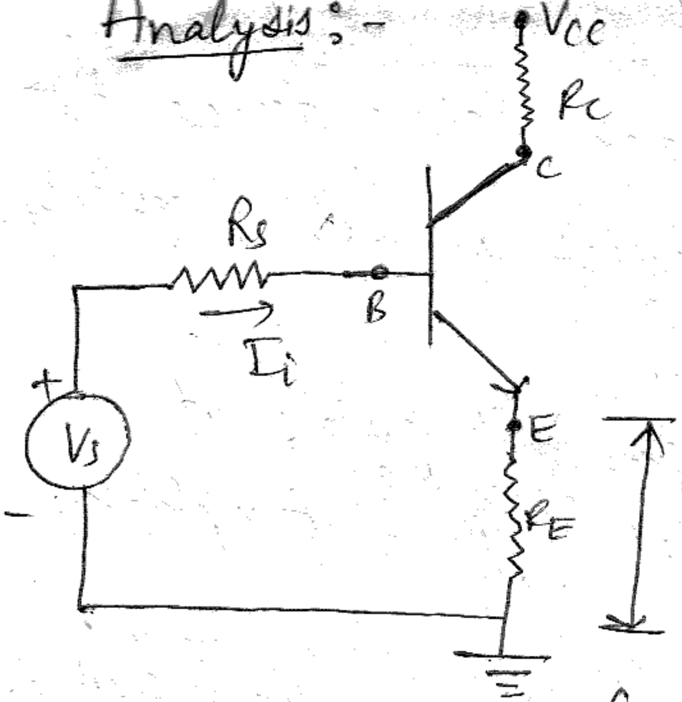
Step7:- From 'A' and 'β' find D i.e Desensitivity, A_f = feedback gain,

R_{if} = i/p resistance with feedback.

R_{of} = o/p resistance with feedback.

R

Analysis :-



here
$V_o = V_f$ = feedback Volt.

from Emitter, feedback is given to base.

Step I (a)

→ It is voltage sampling,

∴ If $V_o = 0$,
feedback voltage $V_f = 0$

⇒ it is voltage sampling

Step I (b) To find type of mixing n/w,

Apply KVL in I/P loop,

$\cancel{-V_s + I_i R_s + V_o = 0}$

$\Rightarrow -V_s + \cancel{I_i R_s} + \cancel{I_i R_E} = 0$

$\Rightarrow V_s = \cancel{I_i R_s + I_i R_E}$

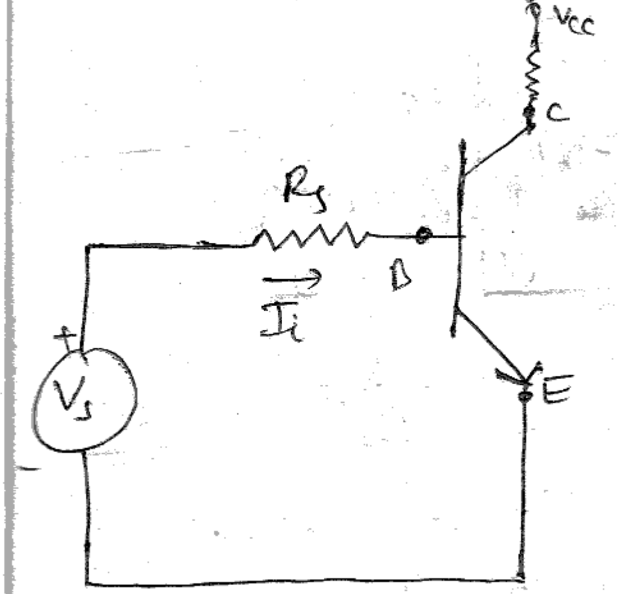
$V_s - I_i R_s - V_o = 0$

$\Rightarrow V_s - I_i R_s - V_f = 0$

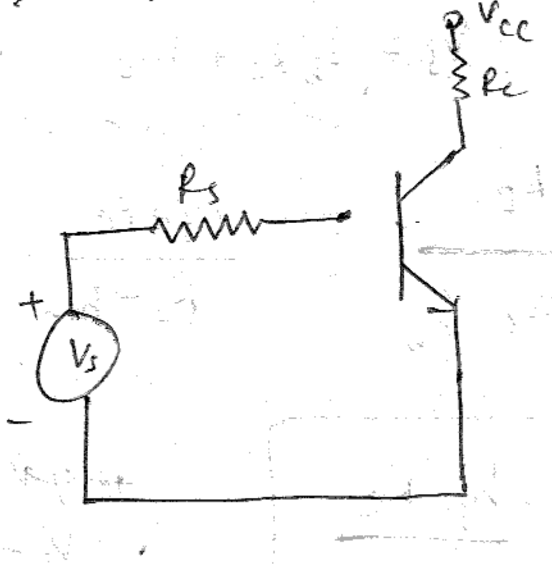
⇒ series mixing

Since feedback voltage is subtracted from source voltage (ie externally applied signal).

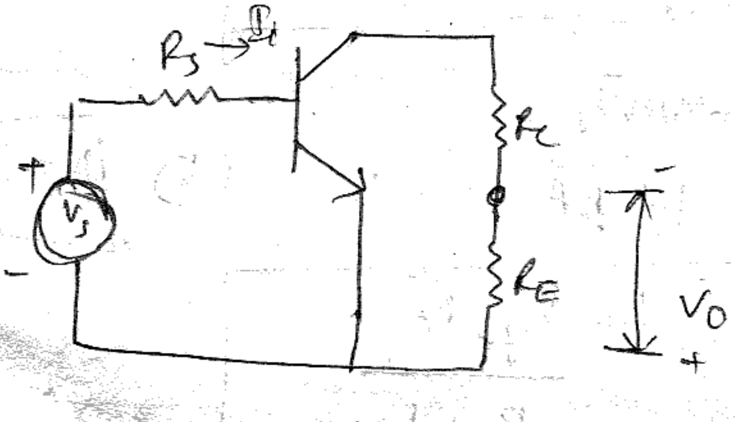
Step 2 for voltage sampling, make $V_o = 0$.



Step 3:- for series mixing, make $I_i = 0$



or



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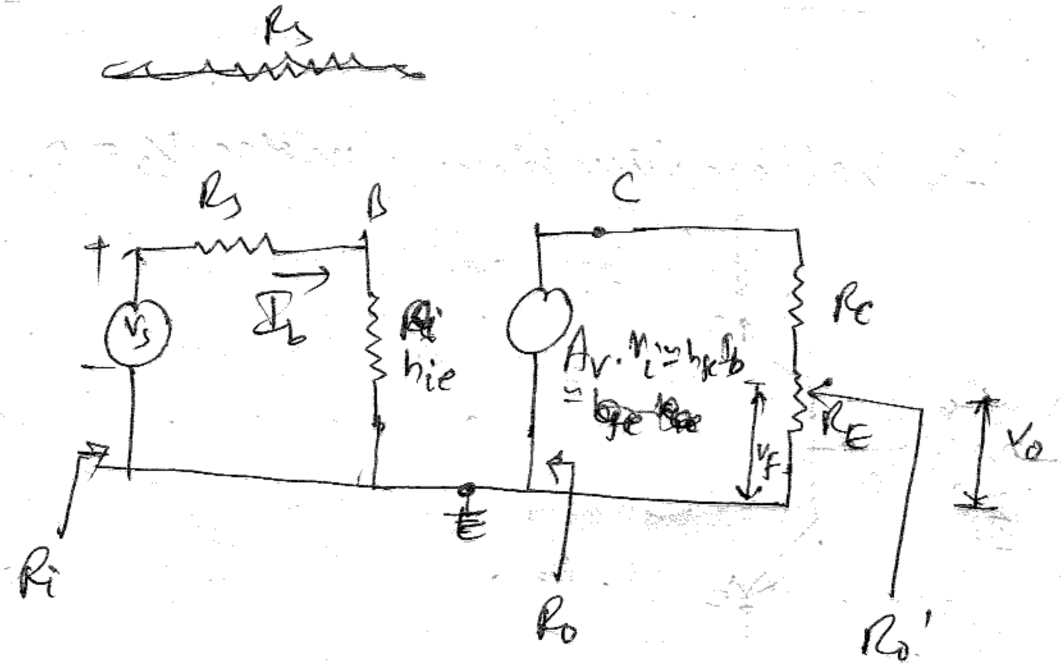
$A_v = \frac{V_o}{V_i}$



$A_v = \frac{V_o}{V_i}$ $\qquad V_o = h_{fe} I_b \times R_e$

$V_s = I_b R_s + h_{ie}$

$$A_v = \frac{h_{fe} I_b \times R_e}{I_b R_s + h_{ie} I_b} = \frac{h_{fe} R_e}{R_s + h_{ie}}$$

(i) $$\boxed{A_v = \frac{h_{fe} R_e}{R_s + h_{ie}}}$$

$\because V_f = \beta V_o$

$\beta = \frac{V_f}{V_o}$

(ii) $\boxed{\beta = 1}$

Desensitivity

(iii) $D = 1 + \beta A$

$$\boxed{D = 1 + \frac{h_{fe} R_e}{R_s + h_{ie}}}$$

A_{vf} = voltage gain with feedback.

$\left[\because D = 1+\beta A\right]$

$$A_{vf} = \frac{A}{1+\beta A} = \frac{A}{D} = \frac{A_v}{1+\frac{h_{fe}R_E}{R_s+h_{ie}}}$$

$$\boxed{A_{vf} = \frac{A_v}{1+\frac{h_{fe}R_E}{R_s+h_{ie}}}}$$

~~$A_{vf} = A_v (R_s$~~

$$A_{vf} = \frac{\frac{h_{fe}R_e}{\cancel{R_s+h_{ie}}}}{\frac{R_s+h_{ie}+h_{fe}R_E}{\cancel{R_s+h_{ie}}}}$$

$$\boxed{A_{vf} = \frac{h_{fe}R_e}{R_s+h_{ie}+h_{fe}R_E}}$$

β $\frac{V_f}{V_o}$ $\because V_o$

R_{if} = I/P resistance with feedback.

$$R_{if} = R_i(1+\beta A_v)$$

$$\boxed{R_{if} = R_i D}$$

$$\boxed{R_{if} = (R_s+h_{ie})D}$$

Now, $\boxed{R_o = \infty}$ By open Ckt'ing.

$$R_{of} = \frac{R_o}{1+\beta}$$

$$\Rightarrow \boxed{R_{of} = \infty}$$

R_{of} = O/P resistance without ~~for~~ $R_L = \infty$

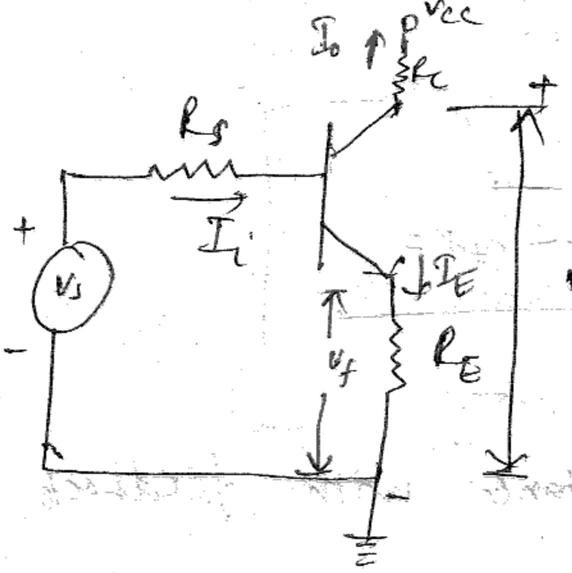
R_{of}' = O/P resistance with feedback $= R_e$

$\because R_{of}' = R_{of} \parallel R_e$

$= \infty \parallel R_e$

$= R_e$

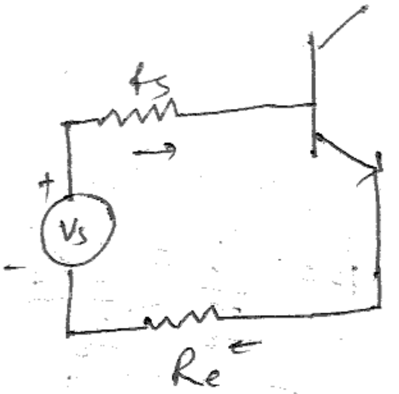
Q2 Find the sampling N/w



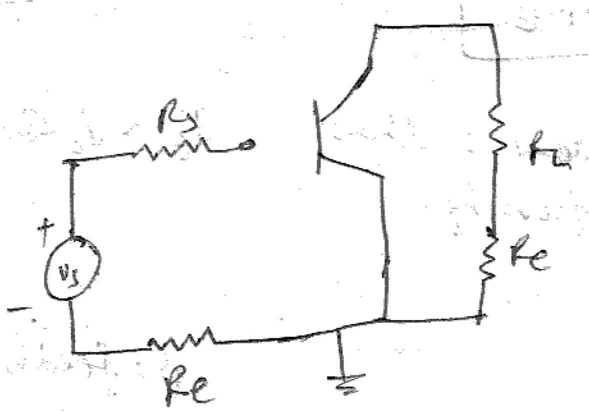
$i = \frac{V}{R}$

$\Rightarrow$ Current series

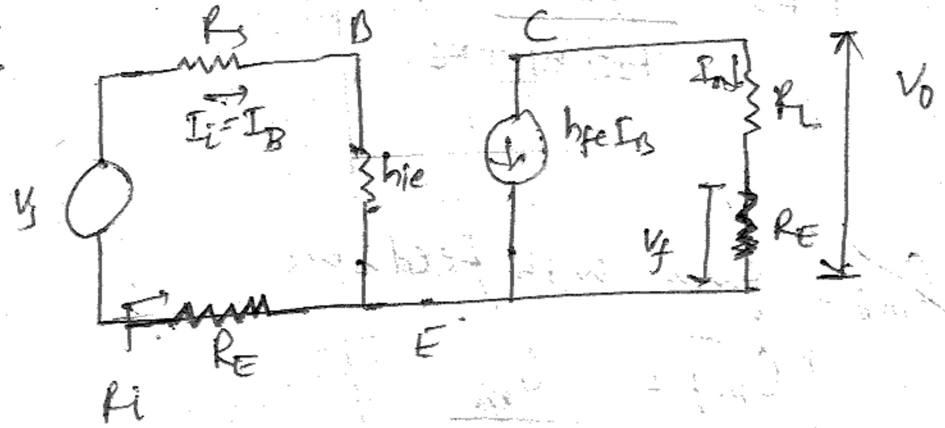
step 2



step3



step4



O/P → current

I/P → voltage.

gain = $\frac{I_o}{V_i}$ ⇒ $G_m = \frac{I_o}{V_i}$

also, $I_o = -h_{fe} I_B$

in loop1,

$$g_m = \frac{-h_{fe} I_B}{V_i} \qquad V_i = I_B(R_s + h_{ie} + R_E)$$

$$= \frac{-h_{fe} I_B}{I_B(R_s + h_{ie} + R_E)} =$$

$$\boxed{G_m = \frac{-h_{fe}}{R_s + h_{ie} + R_E}}$$

$$\beta = \frac{-I_o R_E}{I_o} = R_E$$

$$\boxed{\beta = -R_E}$$

$$\beta = \frac{V}{I_o} = \frac{I_o R_E}{I_o}$$

$$\boxed{\beta = R_E}$$

$\Rightarrow$ minus sign indicates that I_E & I_o are opposite flowing.

Desensitivity, $D = (1+\beta) G_m$

β = feedback factor

$$\boxed{D = (1+\beta)\left(\frac{-h_{fe}}{R_s + h_{ie} + R_E}\right)}$$

G_{mf} = gain with feedback

$$\boxed{G_{mf} = \frac{G_m}{D}}$$

$$G_{mf} = \frac{\dfrac{-h_{fe}}{R_s + h_{ie} + R_E}}{(1+\beta)\left(\dfrac{-h_{fe}}{R_s + h_{ie} + R_E}\right)}$$

$$= \frac{h_{fe}}{R_s + h_{ie} + R_E}$$

$$G_{mf} = \frac{-h_{fe}}{R_s + h_{ie} + R_E} \div \frac{(1+\beta)h_{fe}}{R_s + h_{ie} + R_E}$$

$$= \frac{-\cancel{h_{fe}}}{\cancel{R_s + h_{ie} + R_E}} \times \frac{\cancel{R_s + h_{ie} + R_E}}{(1+\beta)\cancel{h_{fe}}}$$

$$= \frac{-1}{1+\beta}$$

$$\boxed{G_{mf} = \frac{-1}{1+\beta}}$$

Desensitivity,

$$D = 1 + \beta G_m$$

$$= 1 + \beta\left(\frac{-h_{fe}}{R_s + h_{ie} + R_E}\right)$$

$$= \frac{R_s + h_{ie} + R_E - \beta h_{fe}}{R_s + h_{ie} + R_E}$$

$$G_{mf} = \frac{G_m}{D}$$

$$= \frac{\frac{-h_{fe}}{R_s + h_{ie} + R_E}}{\frac{R_s + h_{ie} + R_E - \beta h_{fe}}{R_s + h_{ie} + R_E}}$$

$\beta = -R_E$

$$G_{mf} = \frac{-h_{fe}}{R_s + h_{ie} + R_E + R_E h_{fe}}$$

$$G_{mf} = \frac{-h_{fe}}{R_s + h_{ie} + R_E(1 + h_{fe})}$$