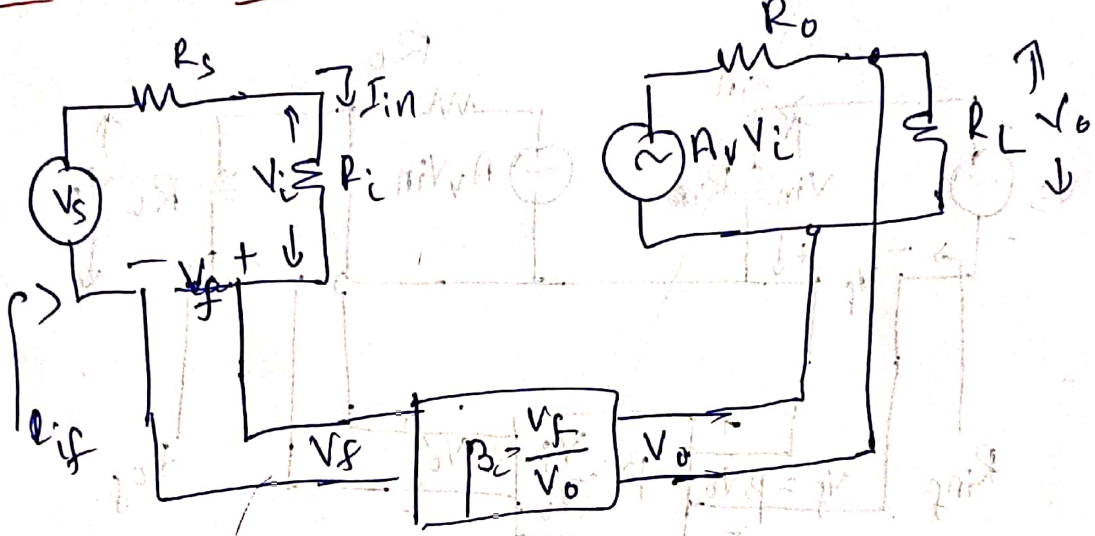
I Effect of negative feedback on input impedance

1) Effect of series mixing:

i) Voltage Series feedback amplifier:



$R_{if} = \frac{V_s}{I_i}$; $\beta = \frac{V_f}{V_o}$ $A_v = \frac{V_o}{V_i}$; $R_i = \frac{V_{in}}{I_{in}}$

W.K.T $V_i = V_s - V_f$

$V_s = V_i + V_f$

$V_s = V_i + [\beta V_o]$ $[\because \beta = \frac{V_f}{V_o}]$

$V_s = V_i + \beta A_v V_i$ $[\because A_v = \frac{V_o}{V_i}]$

$V_s = V_i [1 + \beta A_v]$

Divide Nu & De by I_i

$\frac{V_s}{I_i} = \frac{V_i}{I_i} [1 + \beta A_v]$

$$\boxed{R_{if} = R_i [1 + \beta A_v]}$$

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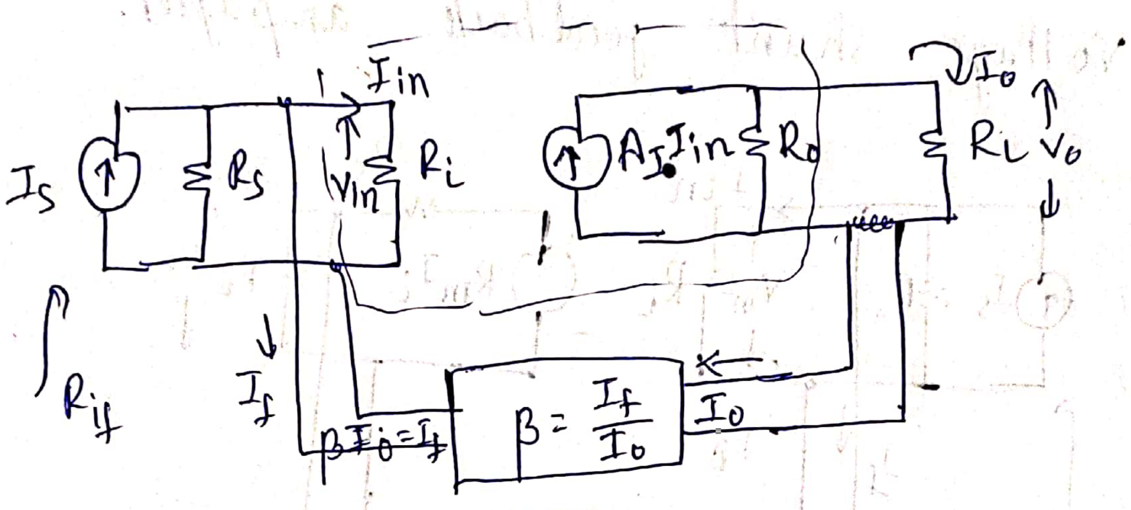
(ii) Current shunt feedback amplifier:



$\beta = \frac{I_f}{I_o}$; $A_I = \frac{I_o}{I_{in}}$

$R_{if} = \frac{V_{in}}{I_s}$; $R_i = \frac{V_{in}}{I_{in}}$

$I_{in} = I_s - I_f$

$I_s = I_{in} + I_f$

$I_s = I_{in} + \beta I_o$ $[\because \beta = I_f / I_o]$

$I_s = I_{in} + \beta A_I I_{in}$ $[\because A_I = \frac{I_o}{I_{in}}]$

$I_s = I_{in}[1 + \beta A_I]$

Divide by V_{in}

$\frac{I_s}{V_{in}} = \frac{I_{in}}{V_{in}}[1 + \beta A_I]$

$$\boxed{R_{if} = \frac{R_i}{1 + \beta A_I}}$$

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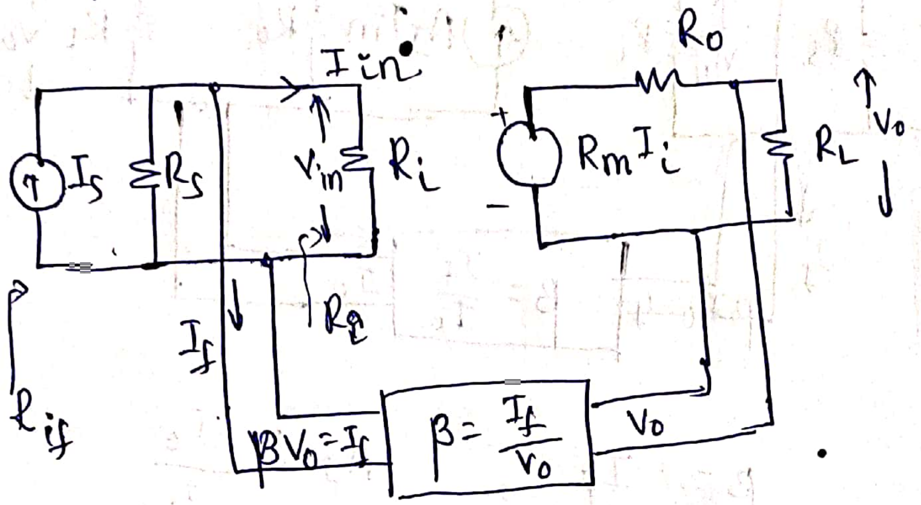
2 Shunt Mixing:

i) Voltage shunt feedback amplifier:



$$\beta = \frac{I_f}{V_o} \qquad R_m = \frac{V_o}{I_{in}}$$

$$R_i = \frac{V_{in}}{I_{in}} \qquad R_{if} = \frac{V_{in}}{I_s}$$

W.K.T $\quad I_{in} = I_s - I_f$

$$I_s = I_{in} + I_f$$

$$I_s = I_{in} + \beta V_o \qquad [\beta = I_f / V_o]$$

$$I_s = I_{in} + \beta R_m I_{in} \qquad [\because R_m = \frac{V_o}{I_{in}}]$$

$$I_s = I_{in}[1 + \beta R_m]$$

divide by V_{in} $\quad \frac{I_s}{V_{in}} = \frac{I_{in}}{V_{in}}[1 + \beta R_m]$

$$\frac{1}{R_{if}} = \frac{1}{R_i}[1 + \beta R_m]$$

$$\therefore \boxed{R_{if} = \frac{R_i}{1 + \beta R_m}}$$

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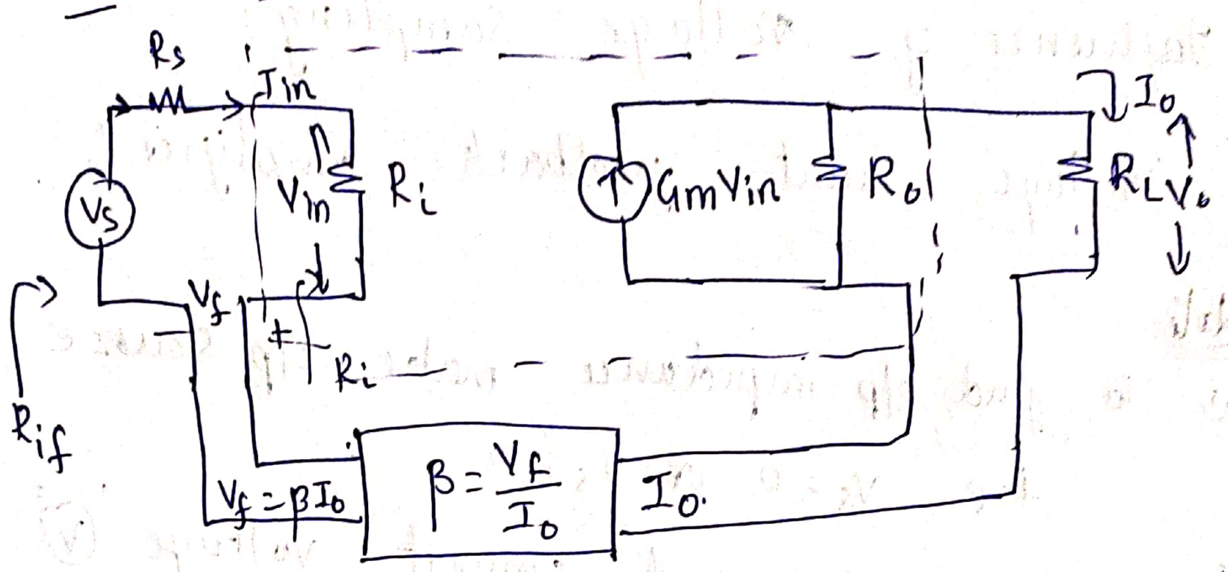
ii) Current Series feedback Amplifier:



$$\beta = \frac{V_f}{I_o} \qquad G_m = \frac{I_o}{V_i}$$

$$R_{if} = \frac{V_s}{I_{in}} \qquad R_i = \frac{V_{in}}{I_{in}}.$$

W.K.T $\quad V_i = V_s - V_f$

$$V_s = V_i + V_f$$

$$V_s = V_i + \beta I_o \qquad [\because V_f = \beta I_o]$$

$$V_s = V_i + \beta G_m V_i \qquad [\because G_m = \frac{I_o}{V_i}]$$

$$V_s = V_i(1 + \beta G_m)$$

Divide by I_{in} on Both sides

$$\frac{V_s}{I_{in}} = \frac{V_i}{I_{in}}(1+\beta G_m)$$

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

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II Effect of -ve feedback on o/p impedance :

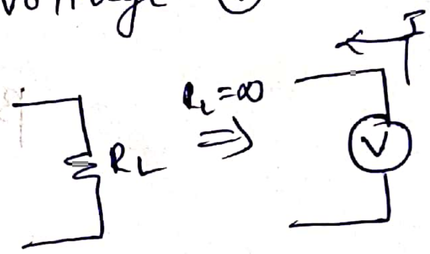
i) Influence of voltage sampling :

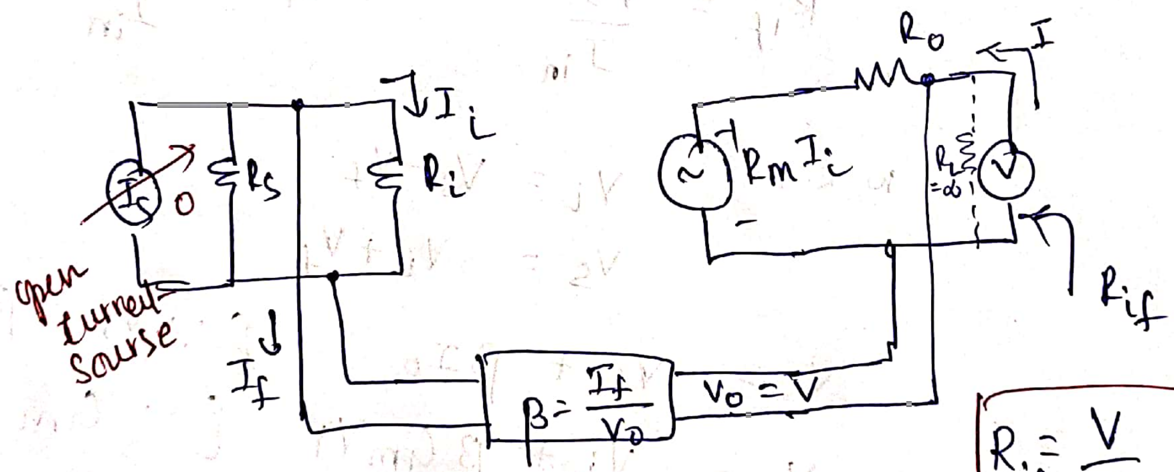
i) Voltage shunt feedback amplifier :

★ **Note:**

1) To find o/p impedance make i/p sourse zero i.e $V_s = 0$ or $I_s = 0$.

2) Remove R_L and connect voltage ⓥ with current flowing 'I'





$$\boxed{R_{if} = \frac{V}{I}}$$

w.k.T $I_i = I_s - I_f$

as $I_s = 0$

$$\boxed{I_i = -I_f} \quad \text{--- (1)}$$

$\beta = \frac{I_f}{V_o} \Rightarrow I_f = \beta V_o$

$$\boxed{I_f = \beta V} \quad \text{--- (2)} \quad [\text{as } V_o = V]$$

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from o/p circuit

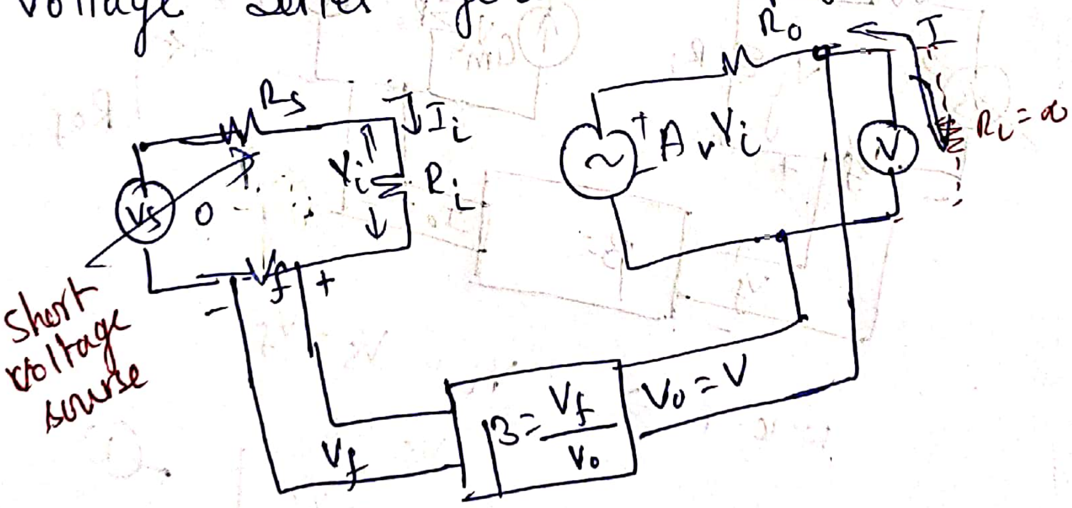
$$I = \frac{V - R_m I_i}{R_o}$$

$$I = \frac{V + R_m I_f}{R_o} \quad [\text{from } ①]$$

$$I = \frac{V + R_m \beta V}{R_o} = \frac{V[1+\beta R_m]}{R_o} \quad [\text{from } ②]$$

$$\frac{V}{I} = \frac{R_o}{1+\beta R_m} \Rightarrow \boxed{R_{of} = \frac{R_o}{1+\beta R_m}}$$

ii) Voltage Series feedback Amplifier:



w.k.T = $V_i = V_s - V_f$

as $V_s = 0$

$$\boxed{V_i = -V_f} \quad — ①$$

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

$$\boxed{V_f = \beta V} \quad — ②$$

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from o/p ckt:

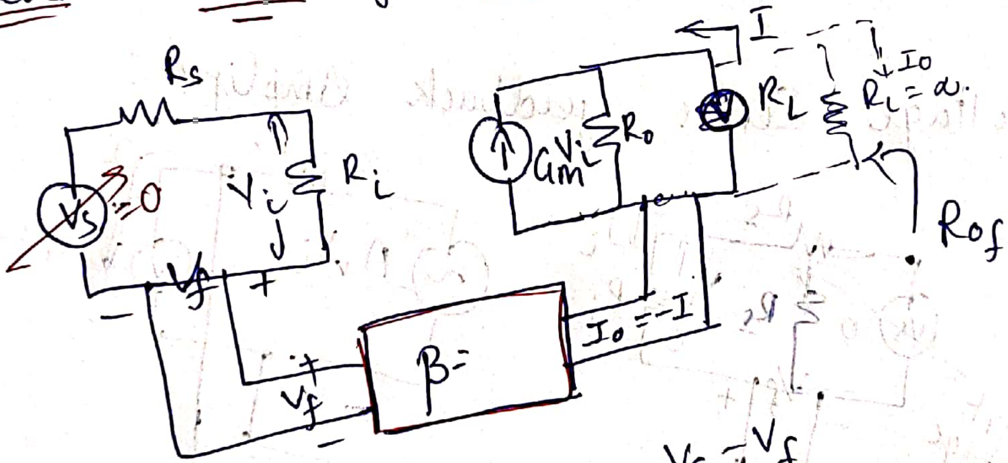
$$I = \frac{V - A_V V_i}{R_o}$$

$$I = \frac{V + A_V V_f}{R_o} = \frac{V + A_V V_f}{R_o}$$

$$I = \frac{V + A_V \beta V}{R_o} = \frac{V[1 + \beta A_V]}{R_o}$$

$$\frac{V}{I} = \frac{R_o}{1+\beta A_V} \Rightarrow \boxed{R_{of} = \frac{R_o}{1+\beta A_V}}$$

3) i) Current series feedback Amplifier:



$$V_i = V_s - V_f$$

w.k.t $\Rightarrow$ $V_s = 0$

$$\boxed{V_i = -V_f} \quad -(1)$$

$$\beta = \frac{V_f}{I_o} \Rightarrow V_f = \beta I_o = \beta(-I)$$

$$\boxed{V_f = -\beta I} \quad -(2)$$

from o/p ckt

$$I + G_m V_i = \frac{V}{R_o}$$

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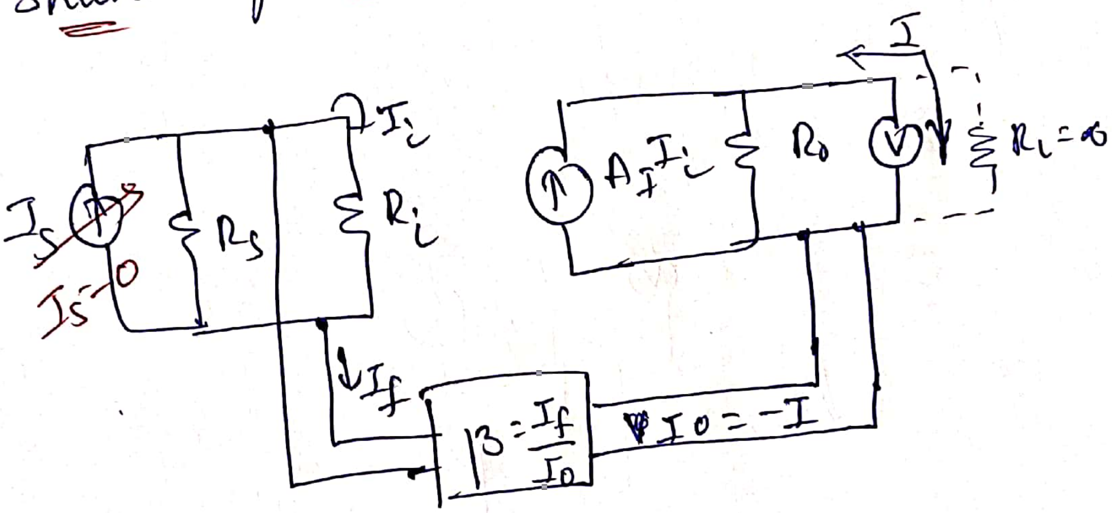
$$\frac{V}{R_o} = I - G_m V_f$$

$$\frac{V}{R_o} = I + \beta I G_m$$

$$\frac{V}{R_o} = I\,[1+\beta G_m]$$

$$\frac{V}{I} = \boxed{R_o\,[1+\beta G_m] = R_{of}}$$

ii Current shunt feedback amplifier:



$$I_i = I_s - I_f$$

as $I_s = 0$

$$\boxed{I_i = -I_f} \quad \text{— (1)}$$

$$\beta = \frac{I_f}{I_o}$$

$$I_f = \beta I_o$$

$$I_f = \beta(-I)$$

$$\boxed{I_f = -\beta I} \quad \text{— (2)}$$

from o/p loop:

$$I + A_I I_i = \frac{V}{R_o}$$

$$\frac{V}{R_o} = I + A_I I_f$$

$$\frac{V}{R_o} = I - A_I(-\beta I)$$

$$\frac{V_o}{R_o} = I + A_I \beta I$$

$$\frac{V}{R_o} = I[1 + \beta A_I]$$

$$\frac{V}{I} = R_o[1 + \beta A_I]$$

$$\boxed{R_{of} = R_o[1 + \beta A_I]}$$

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