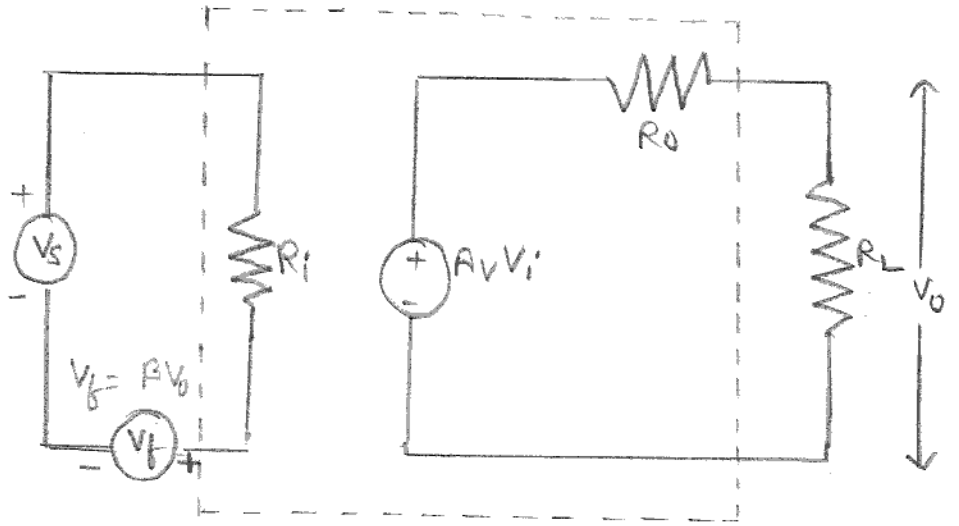
Voltage Series feedback Amplifier

Input Resistance :



The voltage series feedback topology with amplifier is replaced by Thevenin's model and Av represents the open circuit voltage gain takin Rs into account

I/P resistance with f/b

$$R_{if} = \frac{V_s}{I_i} \quad \text{—— (1)}$$

Applying KVL to the i/p side

$$V_s = I_i R_i + V_f$$

$$= I_i R_i + \beta V_o$$

o/p voltage V_o is given as

$$V_o = \frac{A_V V_i R_L}{R_o + R_L}$$

$$= A_V I_i R_i$$

$$V_o = A_V V_i \quad \text{--- (3)}$$

where,

A_V = open ckt voltage gain without feedback.

= voltage gain with f/b with R_L into account.

Sub. V_o from eqn (3) in eqn (2)

$$V_s = I_i R_i + \beta V_o$$

$$V_s = I_i R_i + \beta A_V V_i$$

$$= V_i + \beta A_V V_i$$

$$= V_i (1 + \beta A_V)$$

$$V_s = I_i R_i (1 + \beta A_V)$$

dividing both sides by I_i

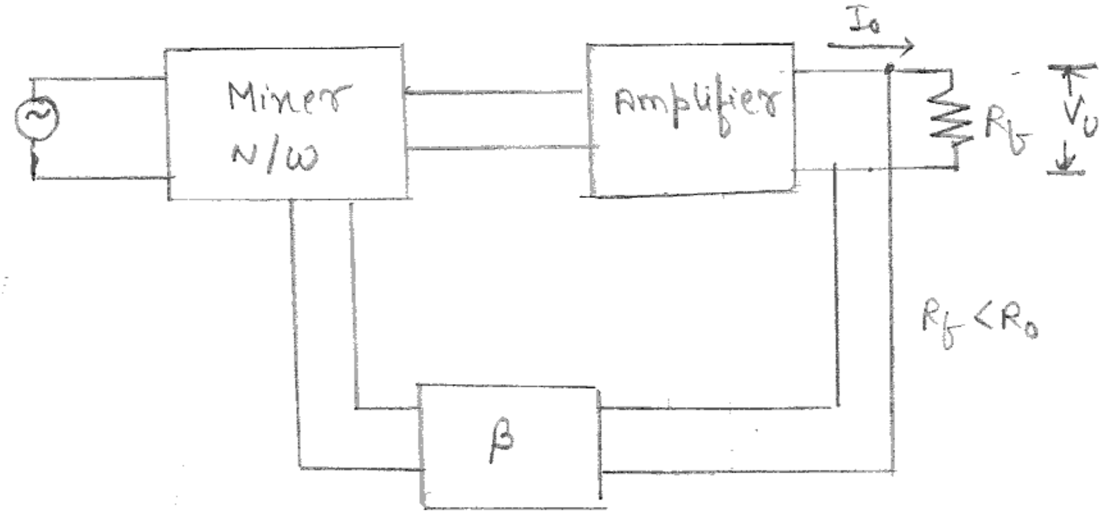
$$\frac{V_s}{I_i} = R_i (1 + \beta A_V)$$

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

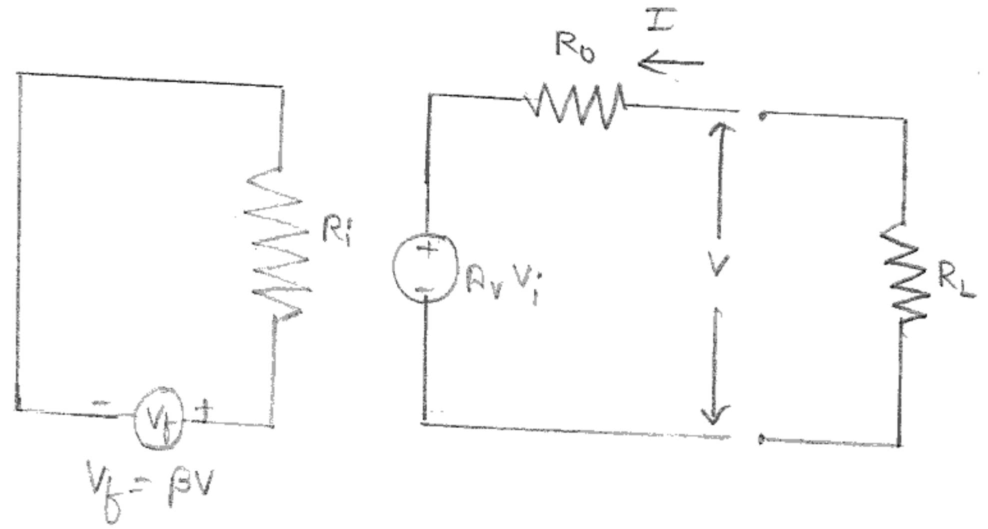
Here, $R_{if} = \frac{V_s}{I_i}$

Output resistance :-

The -ve f/b which samples the o/p voltage regardless of how this o/p signal is return to the i/p



In -ve f/b which is used in the f/b amplifier tends to increase the o/p resistance.



In this topology o/p resistance can be measured by shorting the i/p source $V_s = 0$. The o/p terminal with R_L is connected.

Applying KVL to o/p side

$$A_V V_i + I R_o - V = 0$$

$$I R_o = V - A_V V_i$$

$$I = \frac{V - A_V V_i}{R_o} \quad \text{— (1)}$$

i/p voltage

$$V_i = -V_f = -\beta V \quad \text{— (2)}$$

Sub. V_i from eqn (2) to eqn (1)

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

$$I = \frac{V(1 + A_V \beta)}{R_o}$$

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

where,

A_V = open loop gain without taking R_L into account.

$$R_{of}' = R_{of} \parallel R_L$$

$$R_{of}' = \frac{R_{of} R_L}{R_{of} + R_L} \quad \text{— (3)}$$

Sub R_{of} in eqn (3)

$$R_{of}' = \frac{\frac{R_O}{1+A_V\beta} R_L}{\frac{R_O}{1+A_V\beta} + R_L}$$

$$R_{of}' = \frac{R_O R_L}{R_O + R_L(1+A_V\beta)}$$

Divide numerator and denominator by $(R_O + R_L)$

$$R_{of}' = \frac{\frac{R_O R_L}{R_O + R_L}}{\frac{R_O + R_L(1+A_V\beta)}{R_O + R_L}}$$

Put $\frac{R_O R_L}{R_O + R_L} = R_L'$

& $\frac{A_V R_L}{R_O + R_L} = A_V$

$$\boxed{R_{of}' = \frac{R_L'}{1+\beta A_V}}$$

Here,

A_V = open loop voltage gain taking R_L into account.

Analysing Methodology of feedback Amplifier

Introduction :-

The analysis of feedback amplifier is very important to accurately model the behaviour of an amplifier. The analysis involes amplifier characteristics, overall gain, return ratio, frequency response ; input and output impedance.

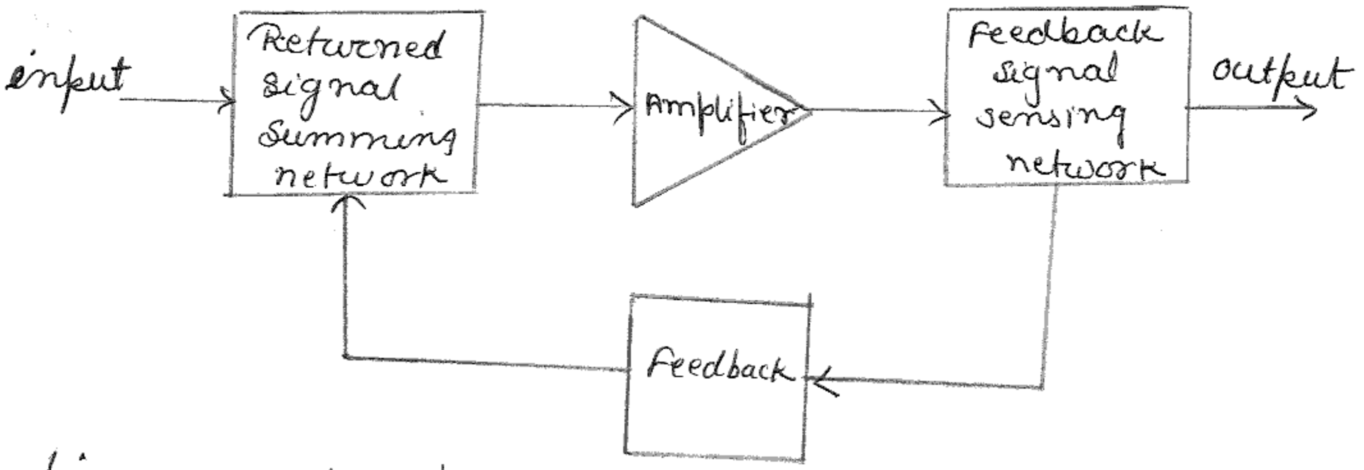


fig :- Ideal block diagram of the feedback system.

It is usually based on modeling the internal amplifier and feedback N/W by two-ports

To analysis the feedback amplifier it is necessary to go through the following steps:-

1) Identify Topology i.e type of feedback :-

To find the type of sampling N/w

i) By shorting the o/p i.e $V_o = 0$ if feedback signal becomes zero then it is called as voltage shunt sampling.

ii) By opening the o/p loop $I = 0$ with f/b signal = 0 then it is called as current shunt sampling.

2) To find out the type of mixing signal :-

i) If the feedback signal is subtracted from the externally applied voltage in the input loop, it is called as series mixing.

ii) If the feedback signal is subtracted from the externally applied current in the input loop, it is called as shunt mixing.

3) <u>To find the input circuit :-</u>

i) For voltage sampling make $V=0$ by shorting the o/p.

ii) For current sampling make $I=0$ by opening the o/p.

4) <u>To find the o/p circuit :-</u>

i) For series mixing make $I=0$ by opening the I/p loop.

ii) For shunt mixing make $V=0$ by shorting the input.

5) Replace each active device by its h-parameter model at low frequency.

6). Find the open loop gain i.e without feedback of the amplifier.

7). Indicate x_f and x_o on the circuit and evaluate $\beta = \frac{V_f}{V_o} = \frac{x_f}{x_o}$

8). From A & β find A_f or A_m, R_{of}, R_{if} and R_{of}'.