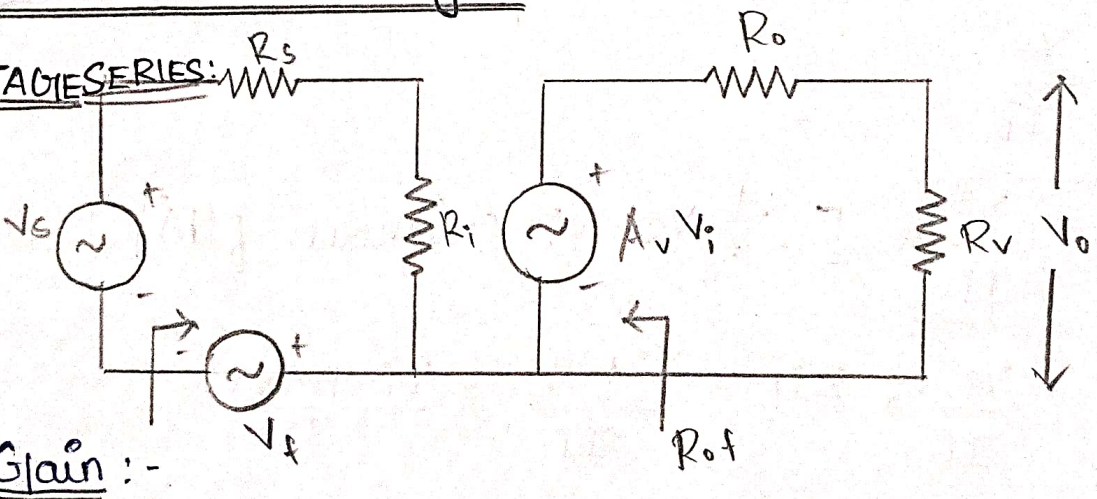
Effect of f/b on gain, i/p resistance, o/p resistance of various f/b topologies :-

VOLTAGE SERIES:



Gain :-

$$A_V = \frac{V_o}{V_s} \quad [\because V_s = V_i \text{ (without f/b)}]$$

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

$$\boxed{V_o = A_V V_i} \rightarrow (1)$$

$$A_{VF} = \frac{V_o}{V_s}$$

$$V_s = V_i + V_F$$

$$A_{VF} = \frac{V_o}{V_i + V_F}$$

$$A_{VF} = \frac{A_V V_i}{V_i + V_F} \quad (\text{from eq(ii)})$$

$$A_{VF} = \frac{A_V V_i}{V_i + \beta A_V V_i} \quad \{ V_F = \beta A_V V_i \}$$

$$= \frac{A_V V_i}{V_i [1 + \beta A_V)}$$

$$\boxed{A_{VF} = \frac{A_V}{1 + \beta A_V}}$$

Input resistance :

$$R_i = \frac{V_s}{I_i}$$

$$\boxed{R_i = \frac{V_i}{I_i}} \quad [\because V_s = V_i \text{ (without } \beta \text{ loop)}]$$

$$R_{if} = \frac{V_s}{I_i} ; \quad R_{if} = \frac{V_i + V_f}{I_i} = \frac{V_i + \beta A_V V_i}{I_i}$$

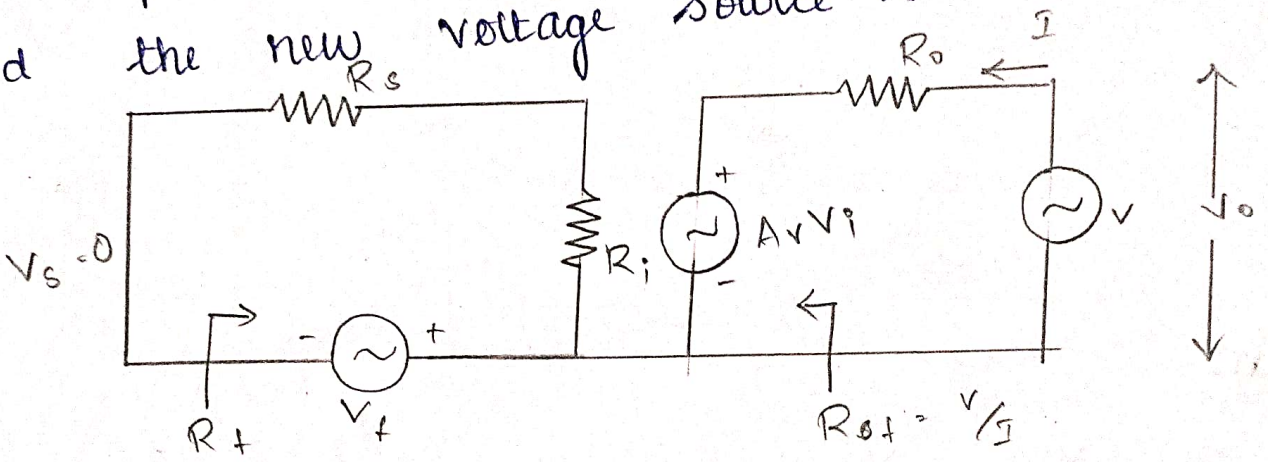
$$R_{if} = \frac{V_i}{I_i} (1 + \beta A_V) \quad \left[\frac{V_i}{I_i} = R_i\right]$$

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

Output resistance:

Steps to find O/p resistance:

* Make the i/p signal source as zero.
* If it is voltage source short circuit the terminals
If if is current source open circuit the terminals
* Open circuit the load R, R_L & in place of R_L add the new voltage source V.



From i/p ckt,

$$V_i = V_s - V_F \qquad [V_s = V_i + V_f]$$

$$V_i = -V_F \qquad [\because V_s = 0]$$

$$V_i = -\beta V \qquad [V_o = V]$$

Apply KVL on O/p side:

$$V = IR_O + A_v V_i$$

$$V = IR_O - A_v \beta V \qquad [V_i = -\beta V]$$

$$IR_O = V + A_v \beta V$$

$$IR_O = V[1 + A_v \beta]$$

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

$$= R_{of}[1 + A_V \beta]$$

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