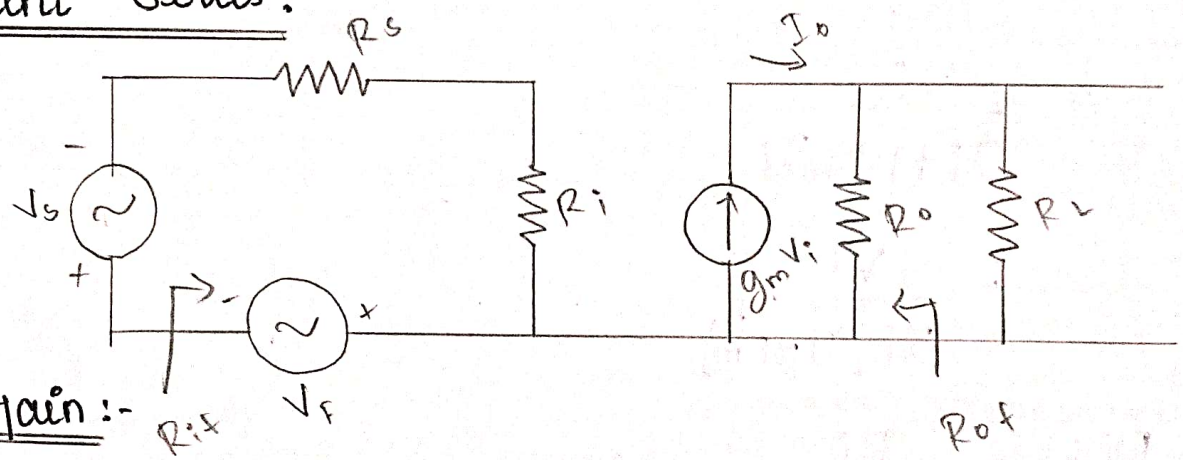
Current Series:



Gain :-

$$g_m = \frac{I_o}{V_s} = \frac{I_o}{V_i^\circ} \qquad [\because V_s = V_i^\circ]$$

$$g_{mf} = \frac{I_o}{V_s} = \frac{I_o}{V_i^\circ + V_F} = \frac{G_m V_i^\circ}{V_i^\circ + \beta I_o} \qquad (I_o = G_m V_i^\circ)$$

$$V_f = \beta I_o$$

$$= \frac{G_m V_i^\circ}{V_i^\circ + \beta G_m V_i^\circ} = \frac{G_m V_i^\circ}{V_i^\circ [1 + \beta G_m]}$$

$$\boxed{G_{mf} = \frac{G_m}{(1 + \beta G_m)}}$$

Input Resistance :

$$R_i^\circ = \frac{V_S}{I_i^\circ}$$

$$R_i^\circ = \frac{V_i^\circ}{I_i^\circ} \qquad [V_S = V_i]$$

$$R_{if} = \frac{V_S}{I_i^\circ} = \frac{V_i^\circ + V_F}{I_i} \qquad [\because V_S = V_i^\circ + V_F]$$

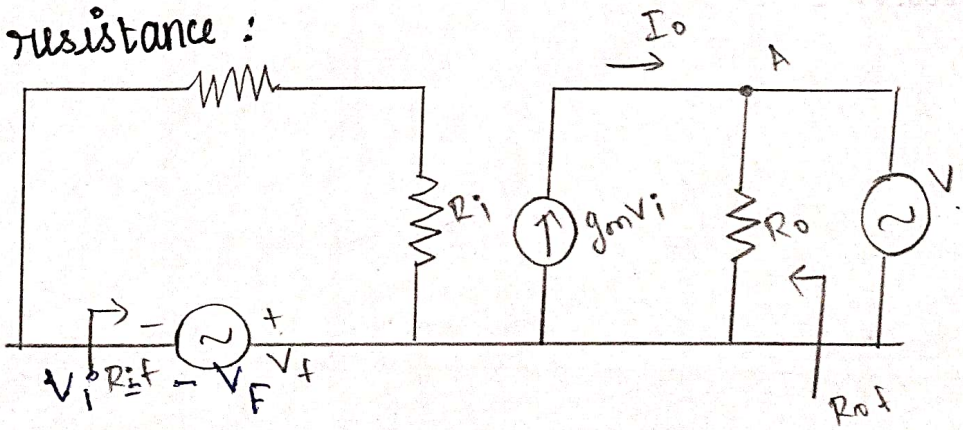
$$= \frac{V_i^\circ + \beta I_0}{I_i^\circ} \qquad [V_F = \beta I_0]$$

$$R_{iF} = \frac{V_i^\circ + \beta G_m V_i^\circ}{I_i^\circ} \qquad [I_0 = G_m V_i^\circ]$$

$$R_{iF} = \frac{V_i^\circ [1 + \beta G_m]}{I_i^\circ}$$

$$\boxed{R_{iF} = R_i^\circ (1 + \beta G_m)}$$

Output resistance :



$$V_i^\circ = -\beta I_0 \qquad \{V_F = \beta I_0\}$$

here,

$$I = I_0$$

$$\therefore V_i^\circ = \beta I$$

From o/p ckt, apply KCL,

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

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

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

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

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

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

$$\boxed{R_{of} = R_o}$$