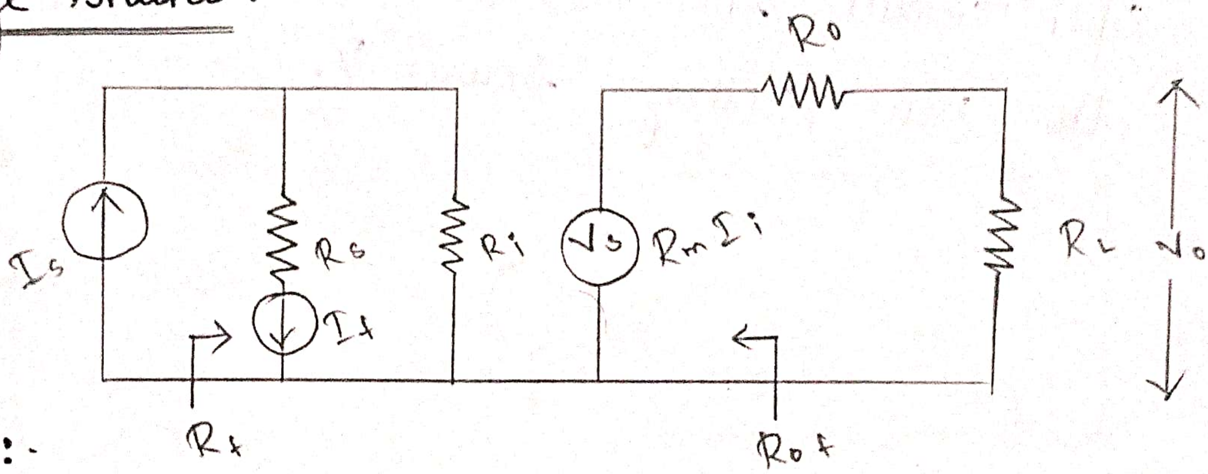
Voltage shunt :



Gain :

$$R_m = \frac{V_o}{I_s} = \frac{V_o}{I_i}$$

$$R_{mf} = \frac{V_o}{I_i + I_F}$$

$$= \frac{V_o}{I_i + \beta I_o}$$

$$= \frac{R_m I_i}{I_i + \beta R_m I_i} \qquad [I_F = \beta R_m I_i]$$

$$= \frac{R_m I_i}{I_i[1+\beta R_m]}$$

$$\boxed{R_{mf} = \frac{R_m}{1+\beta R_m}}$$

Input Risistance :

$$R_i = \frac{V_i}{I_s}$$

$$\boxed{R_i = \frac{V_i}{I_i}}$$

$$= \frac{V_i}{I_s}$$

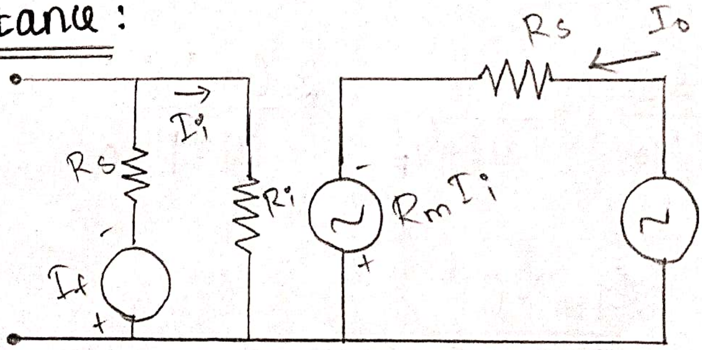
$$R_{if} = \frac{V_i}{I_s} = \frac{V_i}{I_i + I_f}$$

$$= \frac{V_i}{I_i + \beta R_m I_i}$$

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

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

Output resistance :



$I_s = 0$, $I_i = -I_f$ $\{ I_s = I_i + I_F \}$

apply KVL at output node :.

$$\frac{V_o}{R_o} = I_o R_o + R_m I_i$$

$$= I_o R_o + R_m(-I_f)$$

$$V_o = I_o R_o - R_m I_f \qquad \{I_f = \beta V_o\}$$

$$= I_o R_o - R_m \beta V_o$$

$$I_o R_o = V_o + R_m \beta V_o$$

$$= V_o + [1 + R_m \beta]$$

$$R_{of} = \frac{V_o [1 + R_m \beta]}{I_o}$$

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