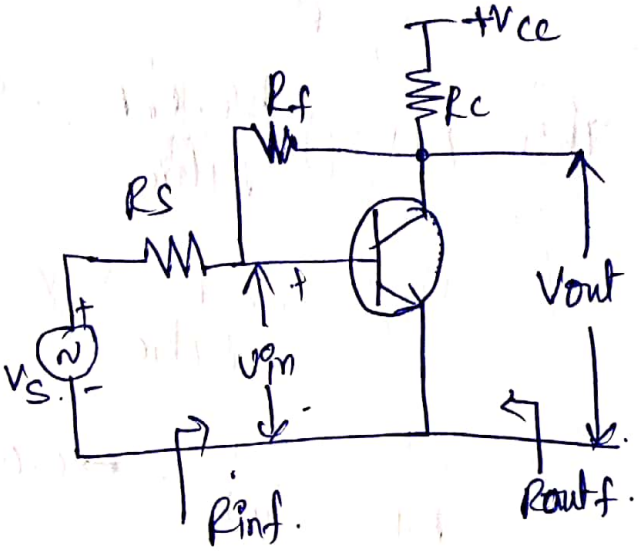
Tutorial -
Feedback Amplifiers.

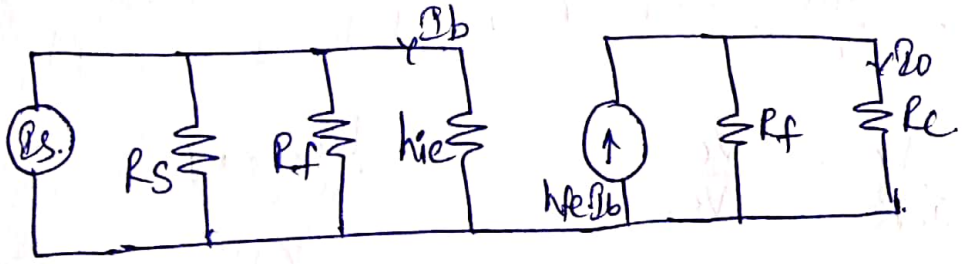
1) The circuit of given below figure has the following parameter

$R_c = 4K\Omega$
$h_{ie} = 1.1K\Omega$
$R_f = 40K\Omega$
$h_{fe} = 50$
$R_s = 10K\Omega$
$h_{oe} = h_{re} = 0.$



Find (i) A_{vf} (ii) R_{inf} (iii) R_{outf}

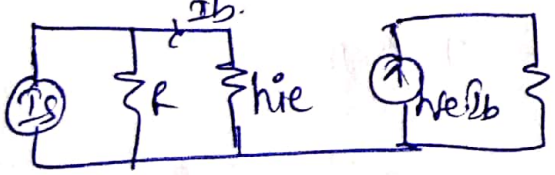
Sol The given circuit is voltage shunt feedback. The equivalent circuit is given by.



Define $R = R_s \| R_f = \frac{5 \times 40}{5+40} = 3.636K\Omega$ $\frac{10 \times 40K^2}{50K} = 8K\Omega$

$R' = R_c \| R_f = \frac{4 \times 40\ K^2}{4+40\ K} = 3.636K\Omega.$

From R & R' the circuit can be remodeled as



From the above circuit

$$R_M = \frac{V_{out}}{I_s} = \frac{-I_c R'}{I_s} = \frac{-h_{fe} \cdot I_b R'}{I_s}$$

$$I_s = \frac{(R + h_{ie}) I_b}{R}$$

Then $$R_M = \frac{-h_{fe} \cdot R' R}{R + h_{ie}} = \frac{-50 \times 3.636 \times 8}{8 + 1.1} = -160 K\Omega$$

$$\therefore I_b = I_s \cdot \frac{R}{R + h_{ie}}$$

$$\beta = \frac{-1}{R_f} = \frac{-1}{40K} = -0.025 mA/V$$

Desensitivity $D = 1 + \beta R_M$

$$= 1 + (+160)(-0.025m)$$

$$D = 5$$

$$R_{Mf} = \frac{R_M}{D} = \frac{-160}{5} = -32 K\Omega$$

$$A_{vf} = \frac{R_{Mf}}{R_s} = \frac{V_o}{I_s R_s} = \frac{V_o}{V_s} \qquad \because \frac{V_o}{I_s} = R_{Mf}$$

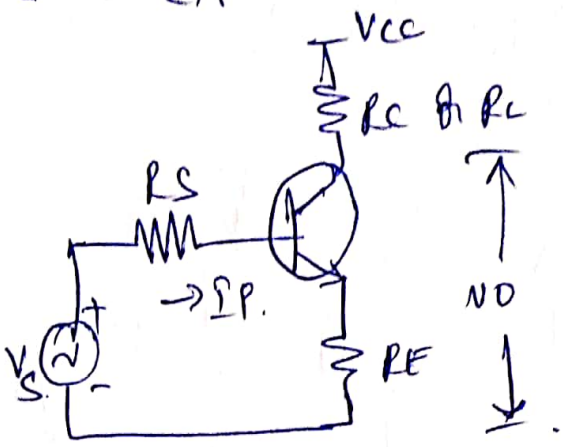
$$A_{vf} = \frac{-32}{10} = -3.2$$

$$R_{in} = \frac{R h_{ie}}{R + h_{ie}} = 0.967 K\Omega$$

$$R_{inf} = R_{in}/D = 193\Omega$$

$$R_{outf} = R_{out}/D = \frac{R'}{D} = \frac{3.636K}{5} = 728\Omega$$

(2). The circuit has an overall transconductance gain of $-1 mA/V$, a voltage gain of -4 & desensitivity of 50. If $R_s = 1K\Omega$, $h_{fe} = 150$, find (a) R_e (b) R_L (c) R_{if}.



Sol $D = 50$.

$G_{Mf} = -1 mA/V$.

$A_{vf} = -4$.

$G_{Mf} = \frac{G_M}{D}$.

$G_M = G_{Mf} \cdot D = -50 mA/V$.

$\beta = -R_e$

$D = 1 + \beta G_M = 50$.

$\beta = \frac{50-1}{-50m} = 0.98K\Omega$.

(a) $R_e = 0.98K\Omega = 1K\Omega$.

(b) $A_{vf} = G_{mf} \cdot R_L$.

$A_{vf} = \frac{I_0 \cdot R_L}{V_S}$

$R_L = \frac{A_{vf}}{G_{Mf}} = \frac{-4}{-1m} = 4K\Omega$

$R_{if} = R_s + h_{ie} + (1 + h_{fe}) R_e$

From $G_M = \frac{-h_{fe}}{R_s + h_{ie} + R_e}$

$h_{ie} = 1K\Omega$