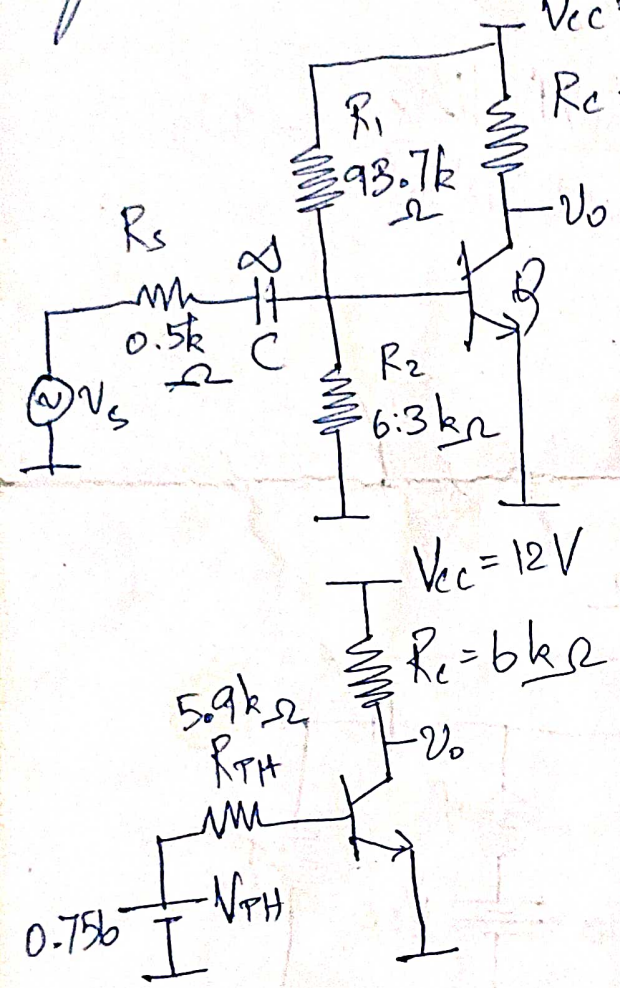
To find incremental equivalent circuit:

1. Short all DC voltage sources and open all DC current sources.
2. Short all capacitors, open all inductors.
3. Replace the transistor with its incremental equivalent circuit.



* Find A_v, R_i and R_o for circuit if

Q: $\beta=100$, $V_{BE(on)}=0.7V$, $V_A=100V$.

For DC the capacitor is open circuit and hence the circuit is

$$I_B=\frac{V_{TH}-V_{BE(on)}}{R_{TH}}$$

$$=9.49\mu A$$

$$I_C=0.949mA$$

$$V_{CEQ}=V_{CC}-I_{CQ}R_C=12-6I_{CQ}$$

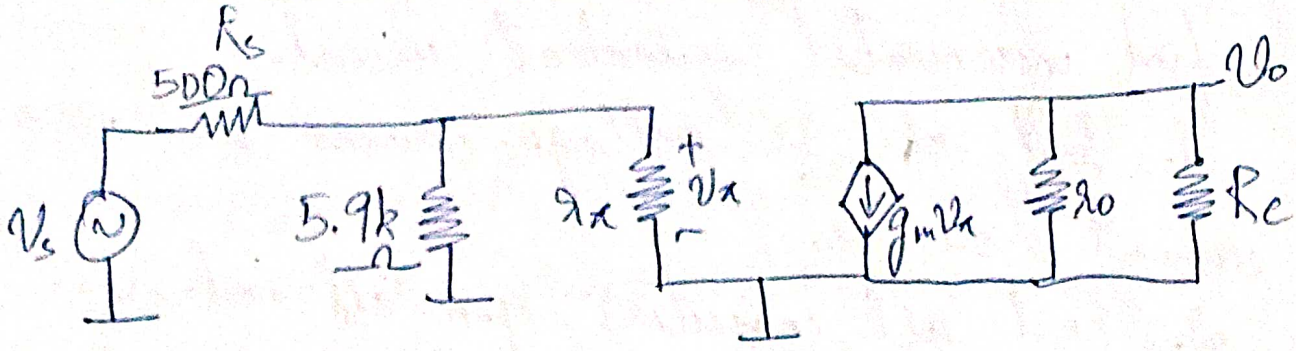
$$=6.305V$$

The device is in Active Region.

$$r_\pi=\frac{V_T}{I_{BQ}}=\frac{V_T\beta}{I_{CQ}}=2.74k\Omega$$

$$g_m=\frac{I_C}{V_T}=36.5mS$$

$$r_o=\frac{V_A}{I_{CQ}}=\frac{100}{0.949}=105k\Omega$$



$$V_x = \frac{R_1 \| R_2 \| r_x}{R_s + R_1 \| R_2 \| r_x} V_s$$

$$V_o = -g_m (R_c \| r_o) V_x$$

$$= -g_m (R_c \| r_o) \times \frac{R_1 \| R_2 \| r_x}{R_s + R_1 \| R_2 \| r_x} \cdot V_s$$

$$A_V = \frac{V_o}{V_s} = -163$$

$$R_i = R_1 \| R_2 \| r_x = 1.87 k\Omega$$

$$R_o = r_o \| R_c = 5.68 k\Omega$$
