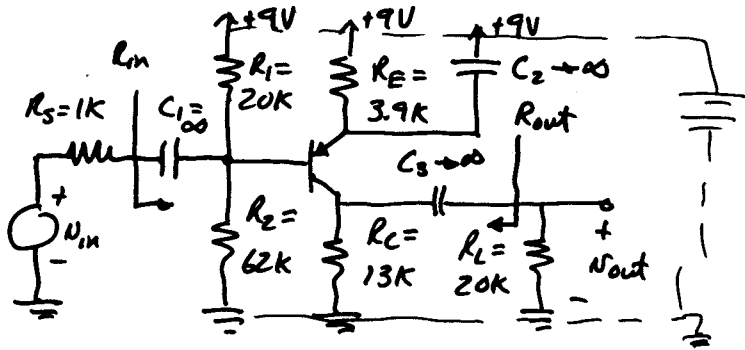


PNP BJT Example

If  $\beta_o = 135$  and  $V_A = 100V$ , find  $\frac{N_{out}}{N_{in}}$ ,  $R_{in}$  &  $R_{out}$ .  
 $V_{BEQ} = -0.7V$

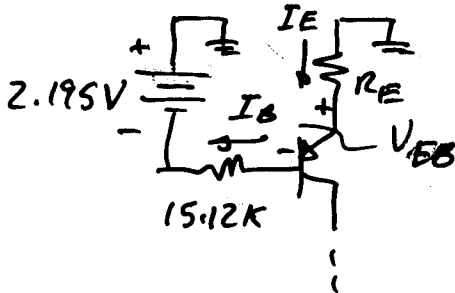
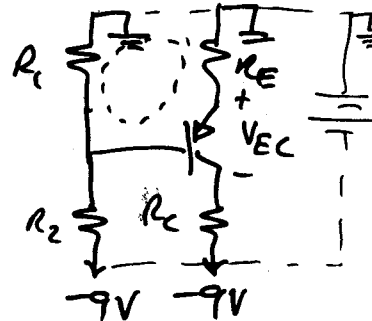
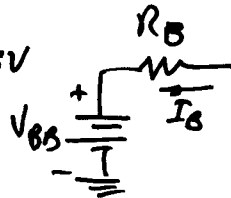


a.) Find Q point.

Another version of the dc ckt.

$$V_{BB} = -9 \frac{R_2}{R_1 + R_2} = -2.195V$$

$$R_B = R_1 || R_2 = 15.12K$$



$$V_{BB} = I_B R_B + V_{BE} + I_E R_E$$

$$-2.195V = -I_B R_B - 0.7V - I_B (1+\beta) R_E$$

$$I_B = \frac{2.195V - 0.7}{R_B + (1+\beta) R_E} = \underline{\underline{2.75\mu A}}$$

c.  $I_C = 135(2.75\mu A) = \underline{\underline{0.37mA}} \rightarrow I_E = I_B + I_C = \underline{\underline{0.373mA}}$

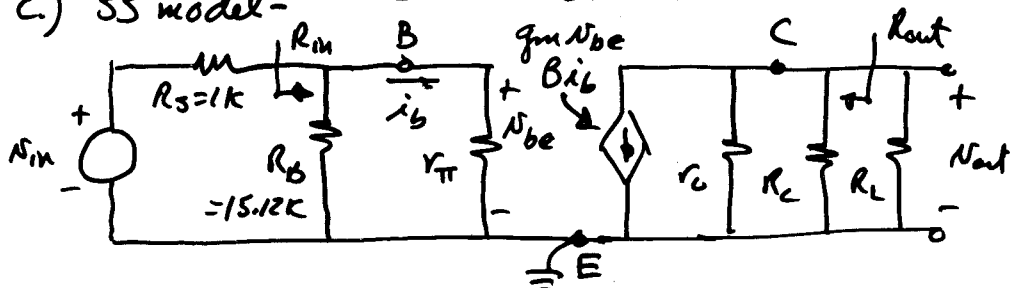
$$V_{EC} = 9 - I_C R_C - I_E R_E = 9 - 4.81 - 1.454 = \underline{\underline{2.736V}}$$

b.) Calculate SS parameters

$$g_m = \frac{I_C}{V_T} = \frac{0.37mA}{25mV} = \underline{\underline{14.8mS}}, \quad r_{\pi} = \frac{\beta}{g_m} = \frac{135}{14.8mS} = \underline{\underline{9.12K}}$$

$$r_o = r_{ce} = \frac{V_A + V_{EC}}{I_C} = \frac{100 + 2.736}{0.37mA} = \underline{\underline{278K}}$$

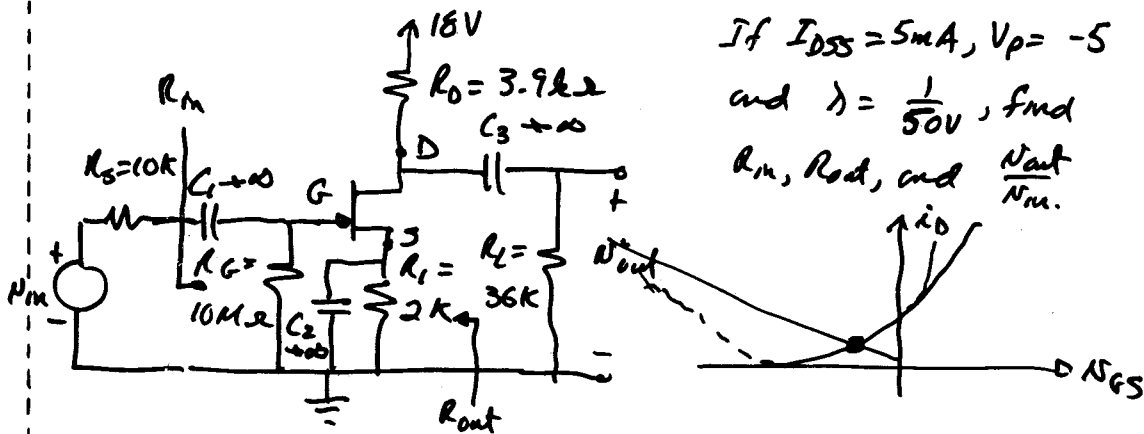
c.) SS model-



Example - Cont'd

$$R_m = R_s \parallel r_{\pi} = \underline{5.69 k\Omega} \quad R_{out} = r_o \parallel R_c = \underline{12.42 k\Omega}$$

$$\begin{aligned} \frac{N_{out}}{N_{in}} &= \left( \frac{N_{out}}{N_{be}} \right) \left( \frac{N_{be}}{N_{in}} \right) = \left[ -g_m (r_o \parallel R_c \parallel R_L) \right] \left[ \frac{R_m}{R_s + R_m} \right] \\ &= \left[ -0.0148 \cdot 7.662 k\Omega \right] \left[ \frac{5.689}{6.689} \right] = \underline{-96.44 V/V} \end{aligned}$$

JFET Example

a.) Q-point

$$\left. \begin{aligned} \text{1st eq.} \quad 0 &= V_{GS} + I_D R_1 \quad \rightarrow \quad V_{GS} = -I_D R_1 \\ \text{2nd eq.} \quad I_D &= I_{DSS} \left( 1 - \frac{V_{GS}}{V_p} \right)^2 \end{aligned} \right\}$$

Quadratic is  $V_{GS}^2 + 12.5V_{GS} + 25 = 0$

$$V_{GS} = -6.25 \pm 3.75 = -2.50V$$

$$I_D = 1.25mA \quad \text{and} \quad V_{DS} = 10.6V$$

b.)