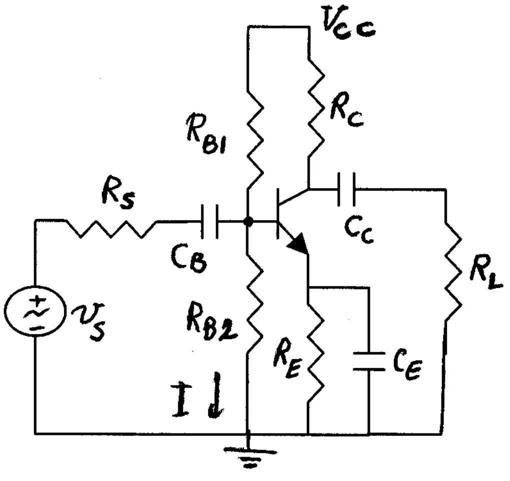
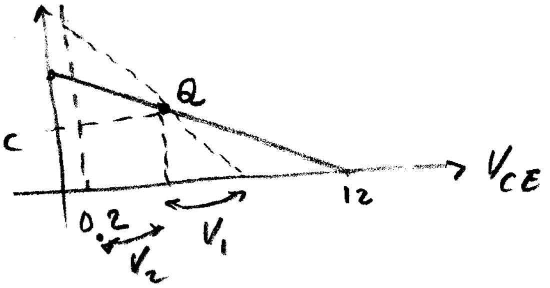
(ECE3455, Q5) In the circuit shown, capacitors are open for DC and short for AC .
The BJT has $V_{CE(sat)}$=0.2[V] and beta=100.
V_{CC}=12[V], R_E=1.2KΩ, R_C=3.3KΩ, R_L=4.7KΩ

a) Find the optimum value of IC so that the output swing(the amplitude of AC part of the output) is a maximum.
b) Find R_{B1} and R_{B2} regarding part (a).
c) Find the maximum amplitude of the output (vo). regarding part (a).



Solution :

DC Load Line $\quad V_{CE} = V_{CC} - I_C (R_C + R_E)$



$$\begin{cases} V_1 = I_C \times (R_C \| R_L) \\ V_2 = V_{CE} - 0.2 = V_{CC} - I_C(R_C + R_E) - 0.2 \end{cases}$$

$V_1 = V_2$

$I_C \times (R_C \| R_L) = V_{CC} - I_C (R_C + R_E) - 0.2$

$R_C \| R_L = 3.3 \| 4.7 = 1.94 \text{ k}\Omega$

$I_C \times 1.94 = 12 - I_C (3.3 + 1.2) - 0.2$

$\boxed{I_C = 1.83 [mA]}$

b) $V_B = 0.7 + R_E \times 1.83 = 0.7 + 1.2 \times 1.83 = 2.9 [V]$

$$\begin{cases} V_B = \dfrac{R_{B2}}{R_{B1} + R_{B2}} \times 12 = 2.9 \\ I = \dfrac{V_{CC} = 12}{R_{B1} + R_{B2}} = 0.1 \times 1.83 = 0.183 \end{cases}$$

dividing the last 2 eqs

$R_{B2} = \dfrac{2.9}{0.183} = 15.84 \text{ k}\Omega$

Continued

$$\begin{cases} R_{B1} + R_{B2} = \dfrac{12}{0.183} = 65.57 \ k\Omega \\ R_{B1} = 65.57 - 15.84 = 49.7 \end{cases}$$

c) $V_o(max) = V_1 = I_C \times (R_C \| R_L)$

$V_o(max) = 1.83 \times 1.94 = 3.55 \ [V]$