CSE 251 ASSIGNMENT 4

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SECTION: 12

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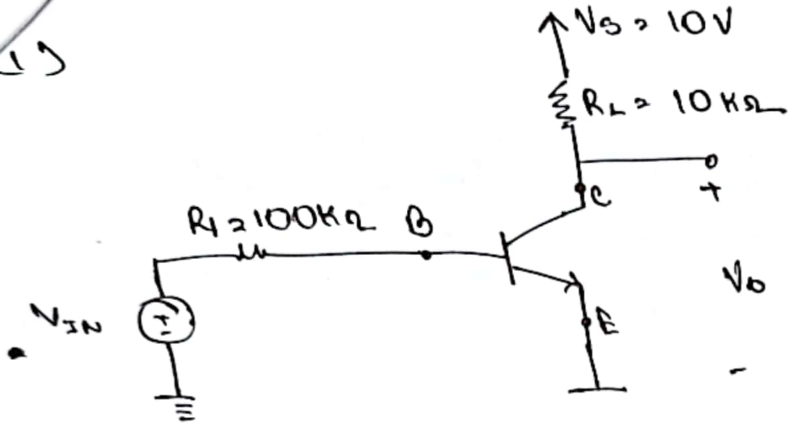
(1)



$0.7 < V_{in} < 0.7 + \left(\frac{V_S - 0.7}{\beta R_L}\right) R_1$

$V_{in} = 0.7 + \left(\frac{V_S - 0.7}{\beta R_L}\right) R_1$

$= 0.7 + \frac{10 - 0.7}{(100)(10)} (100)$

$= 1.68V$

$0.7 < V_{in} < 1.68 \rightarrow$ BJT is in active state

For maximum input voltage swing, the operating points :-

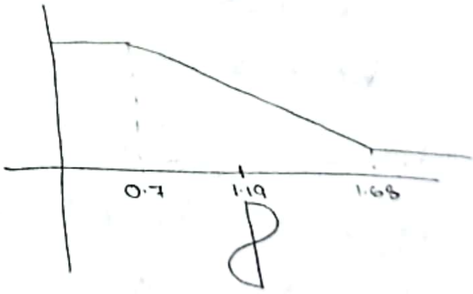
$V_{iq} = \frac{0.7 + 1.68}{2} \Rightarrow V_{iq} = 1.19\ V$

$V_{oq} = \left(V_S + \frac{0.7 \beta R_L}{R_1}\right) - \frac{\beta R_L}{R_1} V_{iq} \Rightarrow \left(10 + \frac{0.7(100)(10)}{100}\right) - \frac{(100)(10)}{(100)} (1.19$

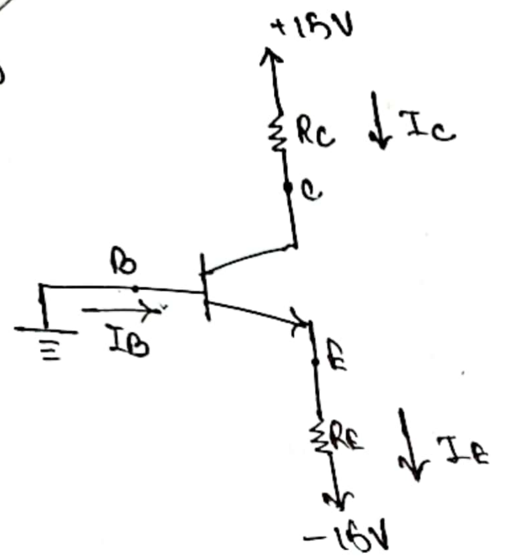
$\therefore V_{oq} = 5.1\ V$

$V_i(t) = 1.68 - 1.19 = 0.49\ V$

$V_{in} = (1.19 \pm 0.49)\ V$



(2)



Let the BJT be in active state ⇒

$V_{BE} = 0.7V$

$V_B - V_E = 0.7 \Rightarrow 0 - V_E = 0.7$

$\Rightarrow V_E = -0.7V$

If $I_C = 2mA$ & $V_C = 5V$,

$V_{CE} = V_C - V_E$

$= 5 - (-0.7)$

$= 5.7 V$

$V_{CE} > 0.2V$

∴ BJT is in active state (proved)

$I_C = \cancel{V_C} \frac{15 - V_C}{R_C}$

$2 = \frac{15 - 5}{R_C}$

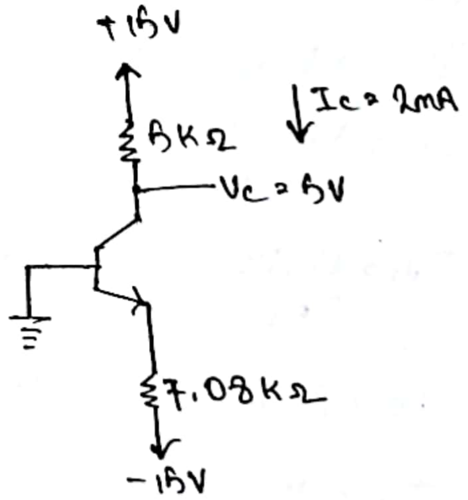
$R_C = 5 K\Omega$

$I_C = \beta I_B$

$2 = 100 I_B \Rightarrow I_B = 0.02 mA$

$I_B + I_C = I_E \Rightarrow 0.02 + 2 = I_E \Rightarrow I_E = 2.02 mA$

$I_E = \frac{V_E - (-15)}{R_E} \Rightarrow 2.02 = \frac{-0.7 + 15}{R_E} \Rightarrow R_E = 7.08 K\Omega$



(Circuit designed)

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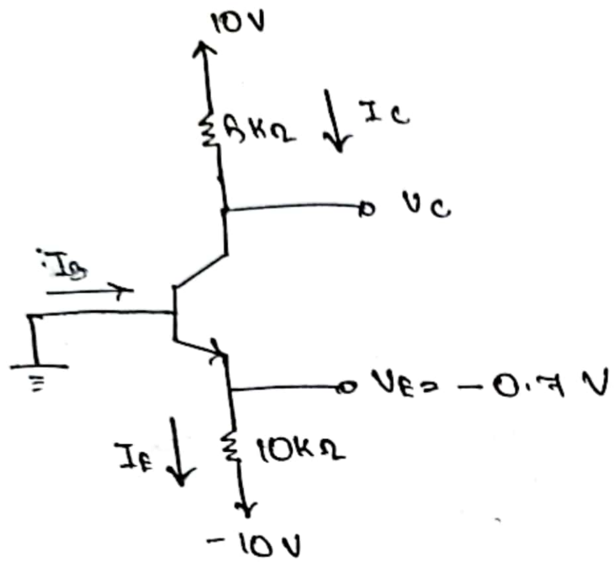
(3)



Let BJT be in active state

$V_{BE} = 0.7V$

$I_B + I_C = I_E \quad [I_C = \beta I_B]$

$I_E = I_B + 50 I_B$

$I_E = 51 I_B$

$I_E = \frac{V_E - (-10)}{10} \Rightarrow I_E = \frac{-0.7+10}{10} \Rightarrow I_E = 0.93 \text{ mA}$

$I_B = \frac{I_E}{51} \Rightarrow I_B = \frac{0.93}{51} \Rightarrow I_B = 0.0182 \text{ mA}$

$I_C = \beta I_B \Rightarrow I_C = (50)(0.0182) = I_C = 0.9118 \text{ mA}$

$I_C = \frac{10 - V_C}{5} \Rightarrow 0.9118 = \frac{10 - V_C}{5} \Rightarrow V_C = 5.44 \text{ V}$

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