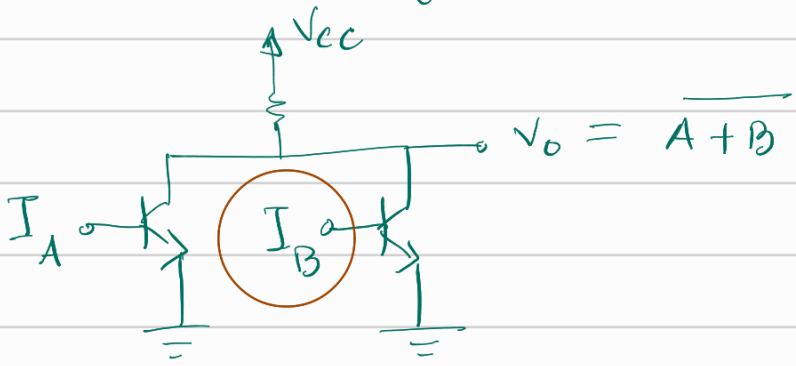
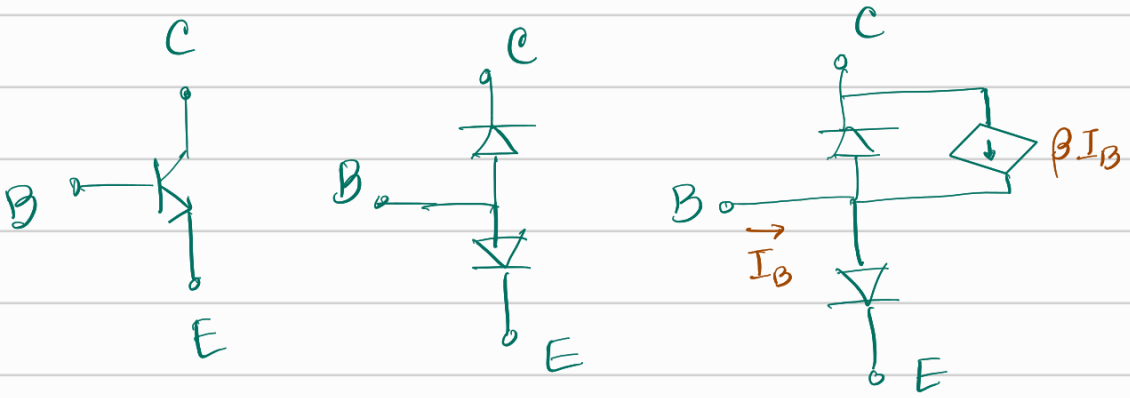
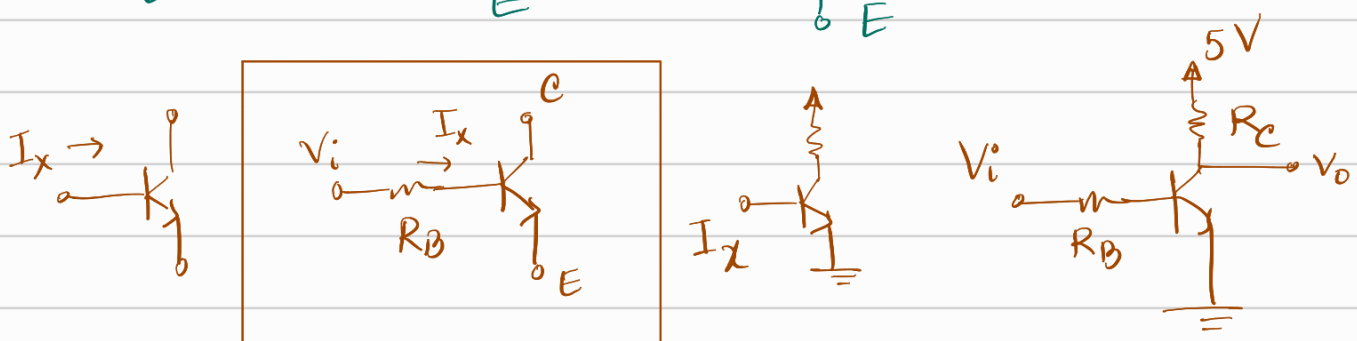
BJT Implementation of $\overline{A+B}$







BJT Inverter :

$V_{BE} = V_B - V_E = V_B$

$V_i = R_B I_B + V_{BE}$

$\Rightarrow I_B = \frac{V_i - V_{BE}}{R_B}$

$I_E = I_B + I_C$

-# $I_C = \frac{V_{cc} - V_o}{R_C}$

Active : linear change

Saturation : $V_{CE} \approx 0$

Cut off : $V_o \approx V_{cc}$

(S-Model) **

Active : linear change

Saturation : $V_{CE} \approx 0.2V$

Cut off : $V_o \approx V_{cc}$

(SV-Model) **

BJT : DC Analysis :- (I) Cut off (II) Active (III) Saturation

(II) Active :

$$I_C = \beta I_B$$

{ β = common emitter current gain }

$$I_E = I_C + I_B = (1+\beta) I_B$$

$$I_E = I_C + \frac{I_C}{\beta} = I_C \frac{1+\beta}{\beta} \Rightarrow I_C = \frac{\beta}{1+\beta} I_E$$

$V_{BE} = 0.7V = V_{D0}$

$$\alpha = \frac{\beta}{1+\beta} \Rightarrow \alpha + \alpha\beta = \beta \Rightarrow \beta(1-\alpha) = \alpha$$

$$\Rightarrow \beta = \frac{\alpha}{1-\alpha}$$

$$\Rightarrow I_C = \alpha I_E$$

Example : $\alpha = 0.99$

$\beta = 100$

 # Verify : $V_{CE} > 0.2\,V$

(II) Saturation :

$V_{CE} = 0.2V$, $V_{BE} = 0.8V$

 # Verify : $I_C < \beta I_B \Rightarrow \frac{I_C}{I_B} < \beta$

(I) Cut off :

$I_C = I_B = I_E = 0$

 # Verify : $V_{BE} < 0.7$, $V_{CE} \gg 0.2\,V$.

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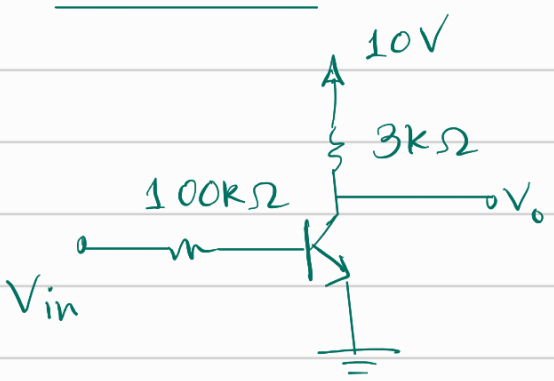
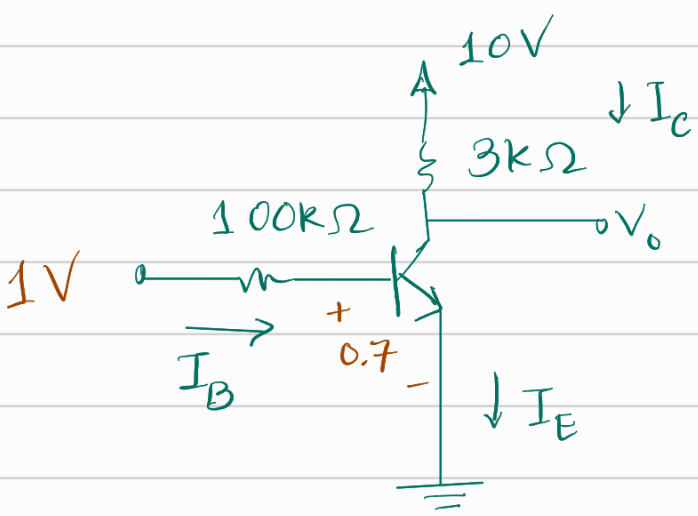
* Example 1 :-



(I) $V_{in} = 1V$	$V_o = 9.1V$
(II) $V_{in} = 5V$	$V_o = 0.2V$

$\beta = 100$

(I) Assume, Active : $V_{BE} = 0.7V$



$$\therefore I_B = \frac{1-0.7}{100} = 0.003mA$$

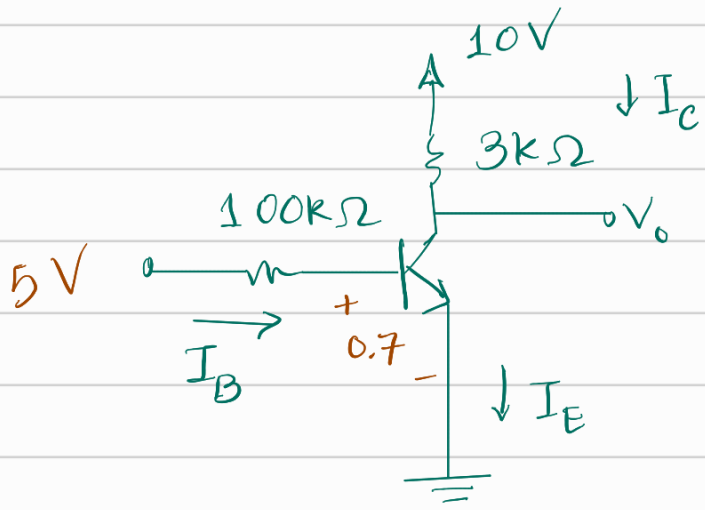
$$I_C = \beta I_B = 100 \times 0.003 = 0.3mA.$$

Verify : $V_{CE} = V_c = 10 - 3I_C$

(✓) $= 9.1V > 0.2V$.

$\therefore V_o = V_c = 9.1V$ (Ans)

① Assume, Active : $V_{BE} = 0.7V$



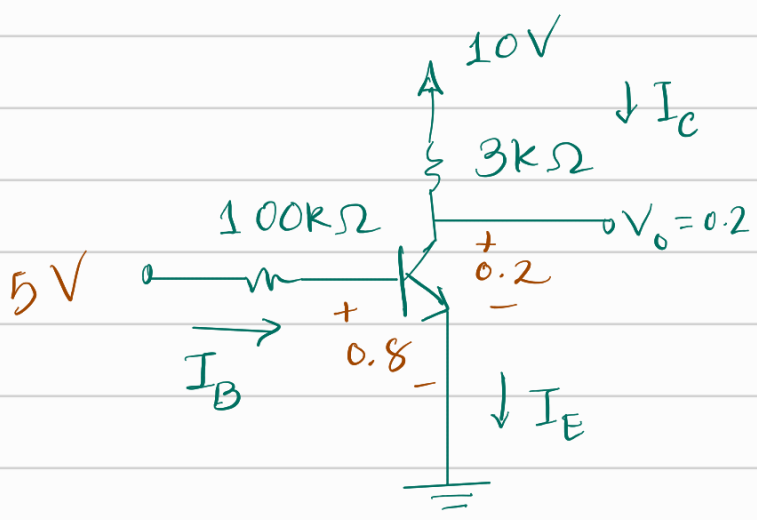
$\therefore I_B = \frac{5-0.7}{100} = 0.043mA$

$I_C = \beta I_B = 4.3mA$.

Verify : $V_{CE} = V_C = 10 - 3I_C$

(×) $= -2.9V < 0.2V$

Assume, Saturation : $V_{CE} = 0.2V$, $V_{BE} = 0.8V$



$\therefore I_B = \frac{5-0.8}{100} = 0.042\ mA$

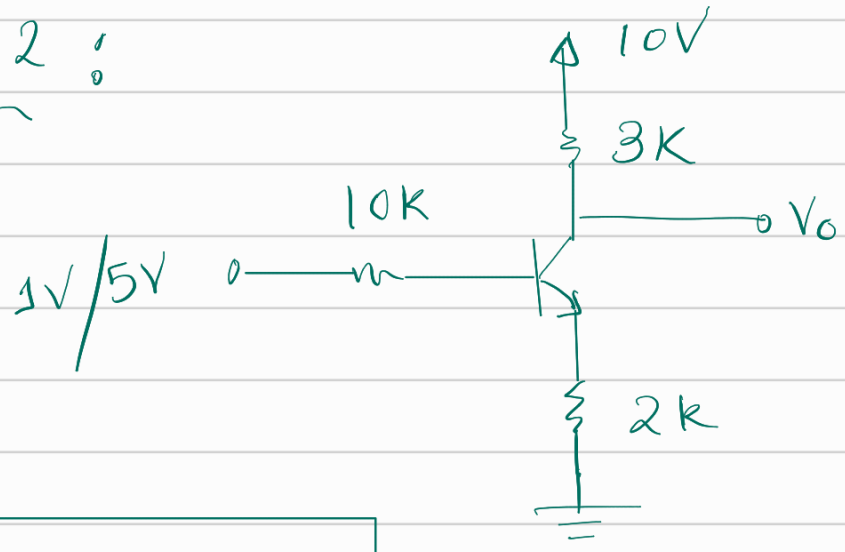
$\therefore I_C = \frac{10-0.2}{3} = 3.267mA$

Verify : $\frac{I_C}{I_B} = 77.79 < \beta = 100$

(✓)

$V_o = V_C = V_{CE} = 0.2V$

Example 2 :



$\beta = 100$

Next Class !!