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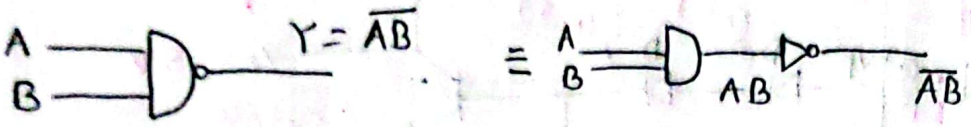
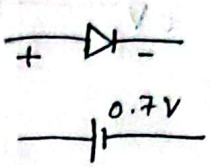
Diode Transistor Logic (DTL)

↓

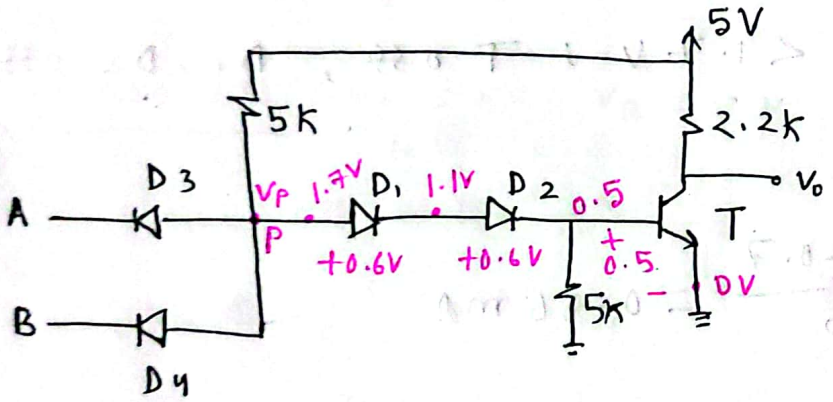
NAND Gate



A	B	AB	Y = $\overline{AB}$
0	0	0	1
0	1	0	1
1	0	0	1
1	1	1	0



if V > 0.6 V,
Diode starts conducting



(i) V_P > 1.7 V, T ON (Satn)

(ii) V_P < 1.7 V, T off (cutoff)

T ON (condition):

V_{BE} > 0.5 V (T ON)

Voltage at point P must be greater than 1.7 V;

V_P > 1.7 V [T ON]

GOOD LUCK

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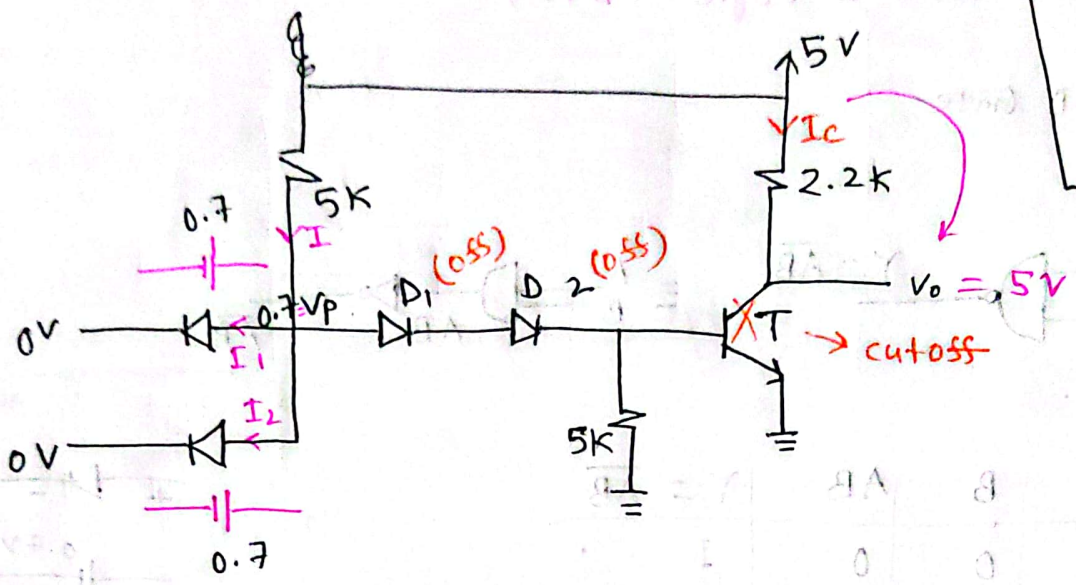

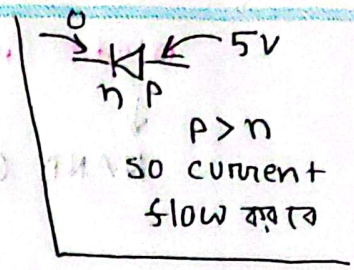

case 1: $V_A = 0V$, $V_B = 0V$, Output = High

D_3, D_4 ON

$V_P = 0.7V < 1.7V$; T off, D_1, D_2 off

$V_o = 5V$

$I_C = 0$

$I = \frac{5 - 0.7}{5} = 0.86\ mA$

$I_1 = I_2 = 0.43\ mA = \frac{I}{2}$

$P_{dis} = (5-0.7)I + (0.7-0)I_1 + (0.7-0)I_2$

$= 1.3\ mW$

Alternative → $P_{dis} = I^2(5) + 0.7I_1 + 0.7I_2$

$= 1.3\ mW$

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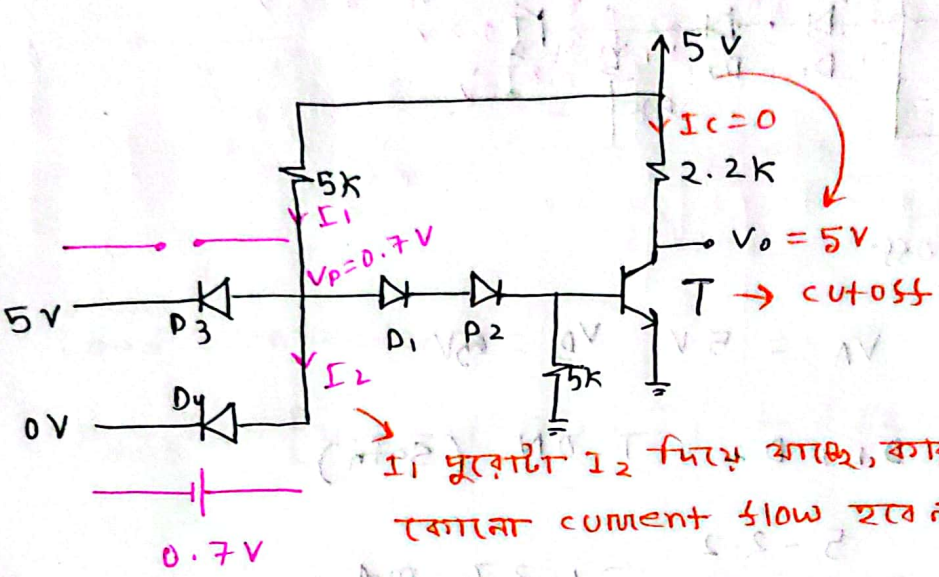
V_A	V_B	V_o	P_{dis}
0	0	5	4.3 mW
0	5	5	4.3 mW
5	0	5	4.3 mW
5	5	0.2	11.14 mW



I_1 পুরোটা I_2 দিয়ে যাচ্ছে, কারণ D_3 এর মধ্য দিয়ে কোনো current flow হবে না।

Case 2 and 3 identical

case 2/3: $V_A = 5V$, $V_B = 0V$, Output high

D_3 off, D_4 ON

V_P @ $= 0.7 < 1.7V$; D_1, D_2, T off

$V_o = 5V$

$$I_1 = \frac{5 - 0.7}{5} = 0.86 \text{ mA}$$

$$I_2 = I_1 = 0.86 \text{ mA}$$

$$P_{dis} = (5 - 0) I_1$$

$$= 4.3 \text{ mW}$$

Alternative → $P_{dis} = I_1^2 (5) + 0.7 I_2 = 4.3$ mW

"GOOD LUCK"

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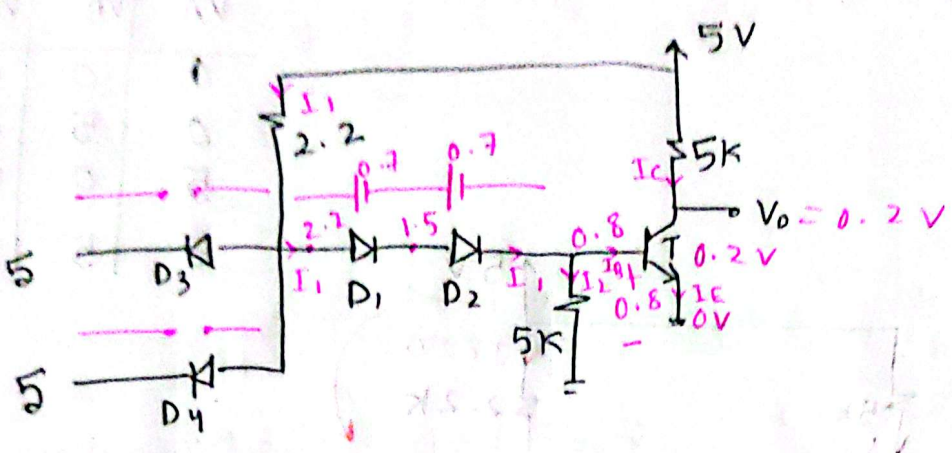


D_3, D_4 off

Case 1: $V_A = 5$ V, $V_B = 5$V

Let D_1, D_2, T ON (Satn)

$$I_1 = \frac{5 - 2.2}{2.2} = 1.27 \text{ mA}$$

$$I_2 = \frac{0.8 - 0}{5} = 0.16 \text{ mA}$$

$$I_B = I_1 - I_2 = 1.11 \text{ mA}$$

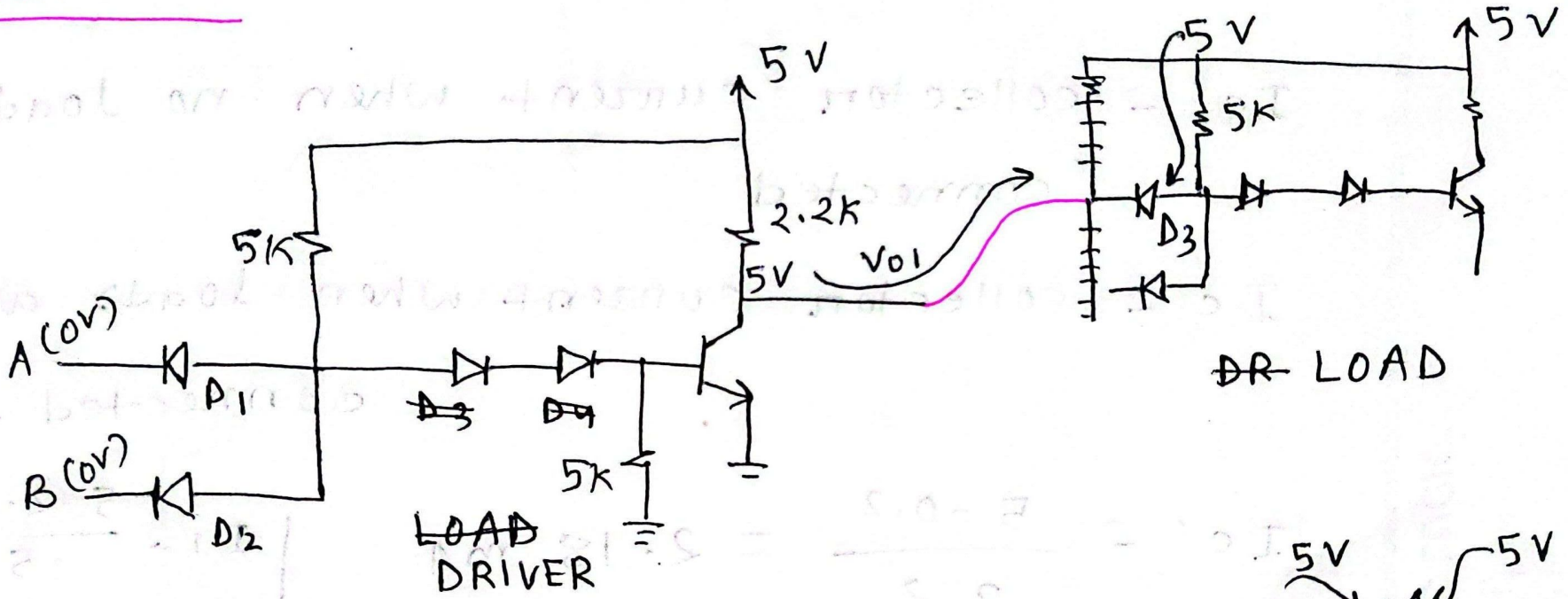
$$I_c = \frac{5 - 0.2}{5} = 0.96 \text{ mA}$$

$$P_{dis} = (5 - 0.8) I_1 + (0.8 - 0) I_2 + (5 - 0) I_c + (0.8 - 0) I_B$$

$$= 11.14 \text{ mW}$$

$$P_{dis} = I_1^2 (2.2) + 0.7 I_1 + 0.7 I_1 + I_2^2 (5) + I_c^2 (5) + 0.8 I_B + 0.2 I_E$$

DTL Fanout



case 1 : (A = 0V, B = 0V), Output high

V_{o1} = 5V, D 3 off

Load and driver are disconnected

fanout = ∞

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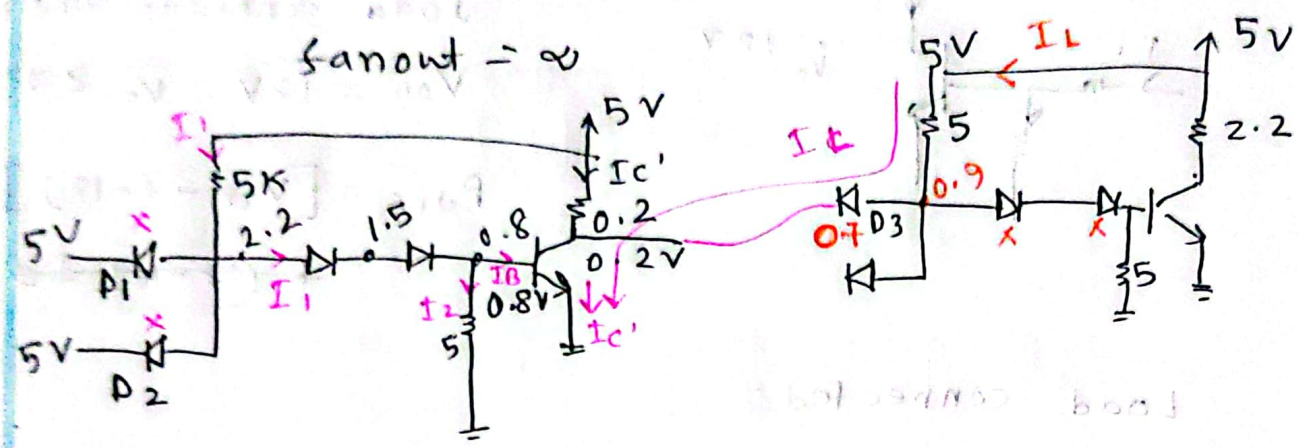
case 2: A = 0V, B = 5V, output high

V_{o1} = 5V ; D 3 off

fanout = ∞



case 3: A = 5V, B = 5V, (D3 ON), output low

I_c' = collector current when no load is connected

I_c = collector current when loads are connected.

$$I_c' = \frac{5 - 0.2}{2.2} = 2.18 \text{ mA}$$

$$I_L = \frac{5 - 0.2 - 0.7}{5} = 0.82 \text{ mA}$$

$$I_c = I_c' + NI_L$$

$$= 2.18 + N \times 0.82$$

$$12 = 2.18 + N \times 0.82$$

$$\therefore N = 11.97 \sim 11$$

$$I_1 = \frac{5 - 2.2}{5} = 0.56$$

$$I_2 = \frac{0.8}{5} = 0.16$$

$$I_1 = I_2 + I_B$$

$$\therefore I_B = 0.4 \text{ mA}$$

$\beta_{forced} = 30$

$$\frac{I_C}{I_B} = 30$$

$$\therefore I_C = 12 \text{ mA}$$

GOOD LUCK

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satn : $\beta_{forced} < \beta_F$

if $I_c \uparrow$, $\beta_{forced} \uparrow$

Transition : $\beta_{forced} \simeq \beta_F$

Fanout = min (α , 11) = 11