CSE 350 HW 3

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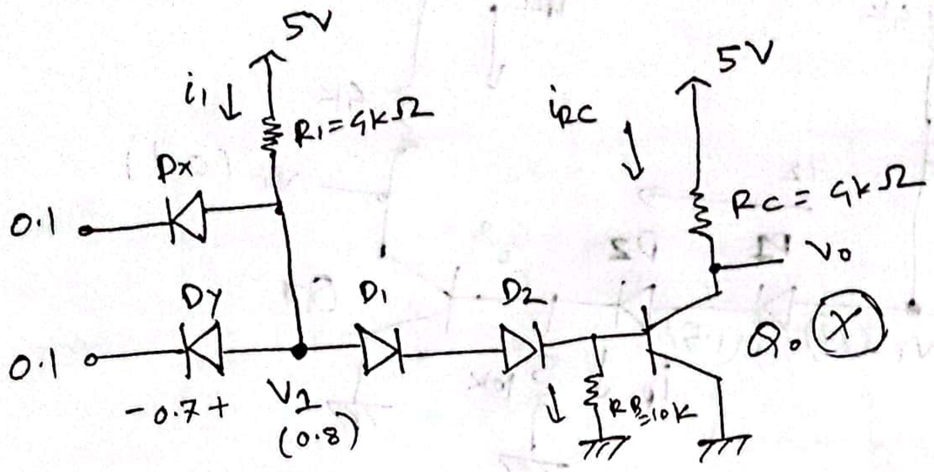
20101537

Ans. to the question no. 02:

(a)



Here,

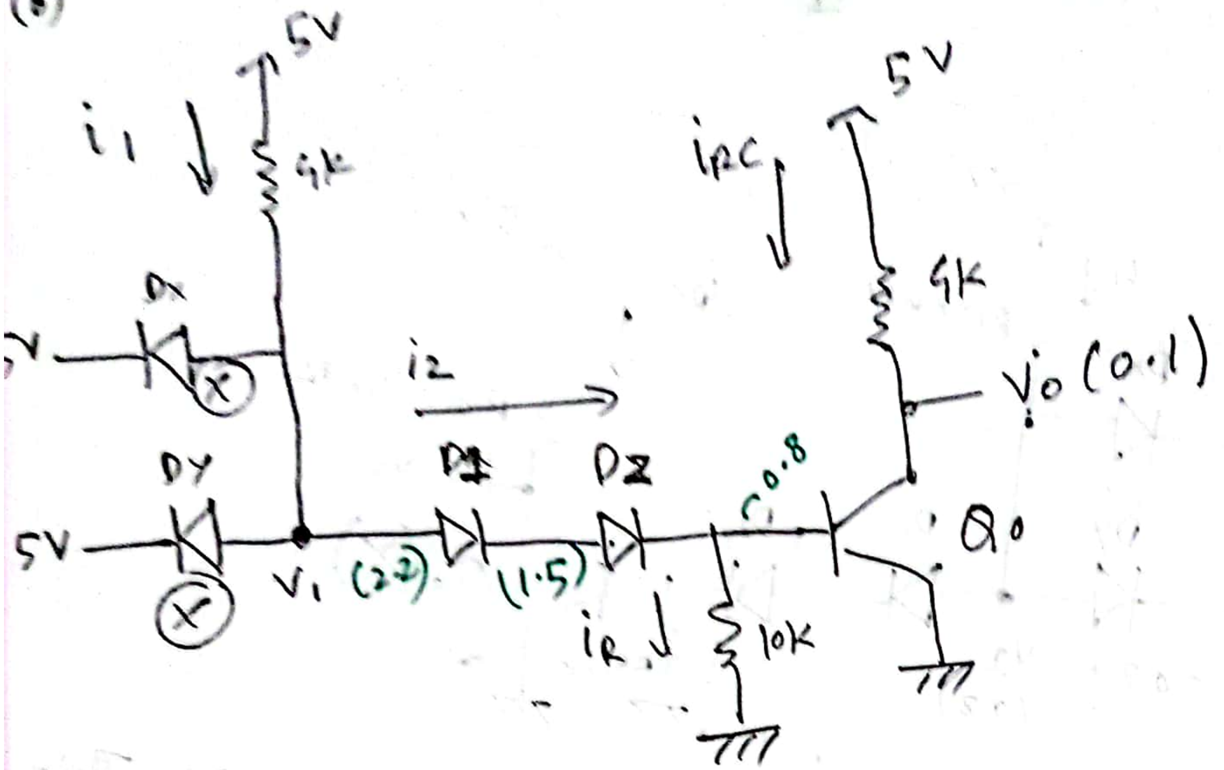
0.1 ——▷|—— V_1 $V_1 = (0.1 + 0.7) = 0.8V$. This
- 0.7 +

voltage can not turn on the transistor. Therefore, Q_0 will be in cut-off.

$$\therefore i_1 = \frac{5 - 0.8}{4k} = 1.05\,mA$$

And $i_2 = i_R = i_B = i_{RC} = 0$

(b)



Since, Dx and Dy are off. So all currents will flow through Qo, and will be in saturation.

$\therefore V_o = V_{CE} = 0.1V$ and $V_1 = 2.2V$

$\therefore i_1 = \dfrac{5-2.2}{4K} = 0.7mA$

$i_2 = i_1 = 0.7mA$

$i_R = \dfrac{0.8-0}{10K} = 0.08mA$

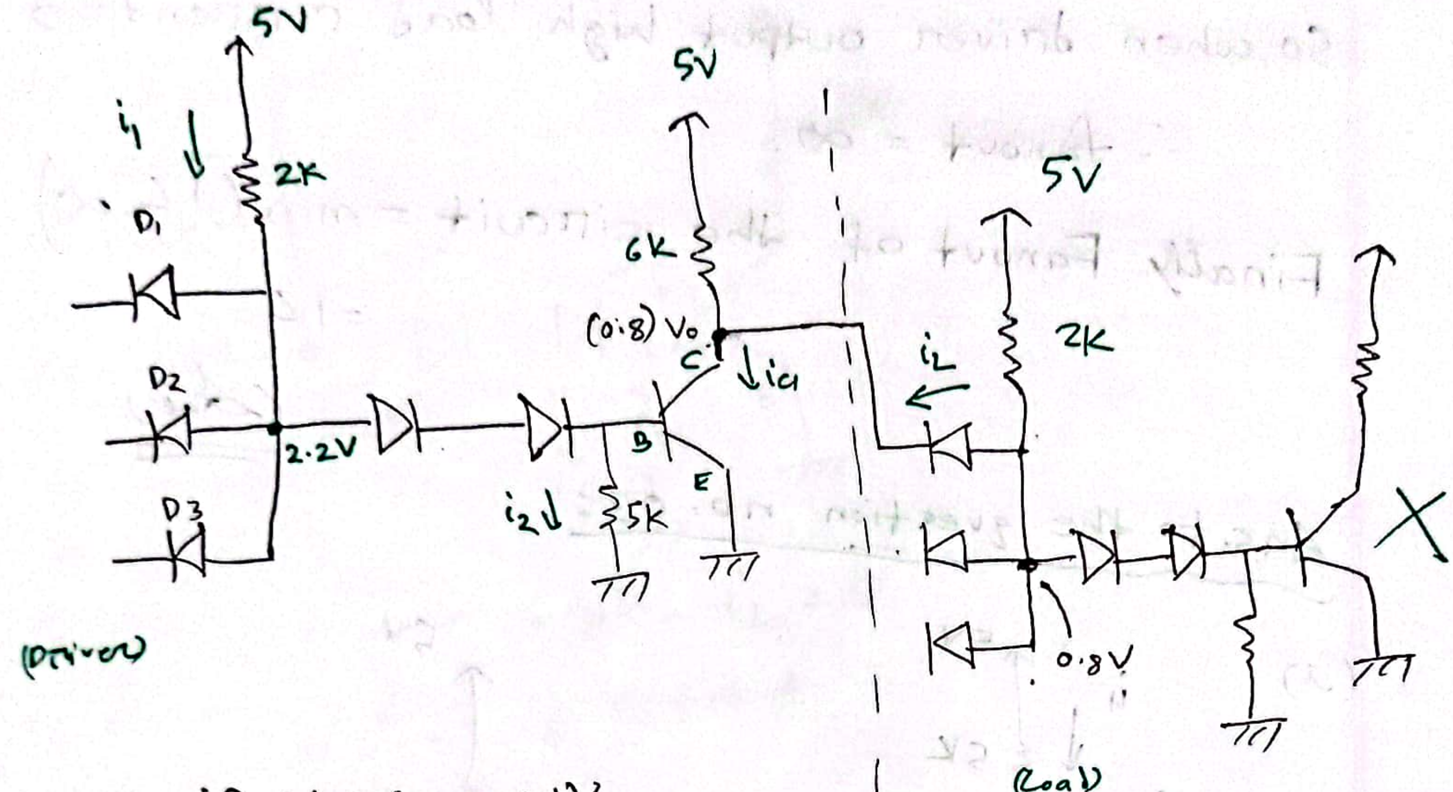
$\because i_2 = i_B + i_R$

$\therefore i_B = i_2 - i_R = 0.62 mA$

$\therefore i_{RC} = \dfrac{5-0.1}{4K} = 1.225 mA$

(Anil)

Ans. to the question no.02:



case 1: if $V_o = low = 0.1V$

$$i_L = \frac{5-0.8}{2k} = 2.1mA$$

$$i_3 = \frac{5-0.1}{6k} = 0.817mA$$

So, $i_c' = i_L \times N + i_3$

Now,

$$i_L \times N + i_3 = \beta_{forced} \times i_B$$

$$\Rightarrow 2.1 \times N + 0.817 = 25 \times i_B$$

$$\therefore N = \left\lfloor \frac{(25 \times 1.24) - 0.817}{2.1} \right\rfloor$$

$= 14$

$$i_1 = \frac{5-2.2}{2K} = 1.4mA$$

$$i_2 = \frac{0.8-0}{5K} = 0.16mA$$

$$i_B = i_1 - i_2 = 1.24mA$$

Case 2: if V_o = high = 5V so, $i_L = 0$

So, when driver output high load current = 0

$\therefore$ fanout = ∞.

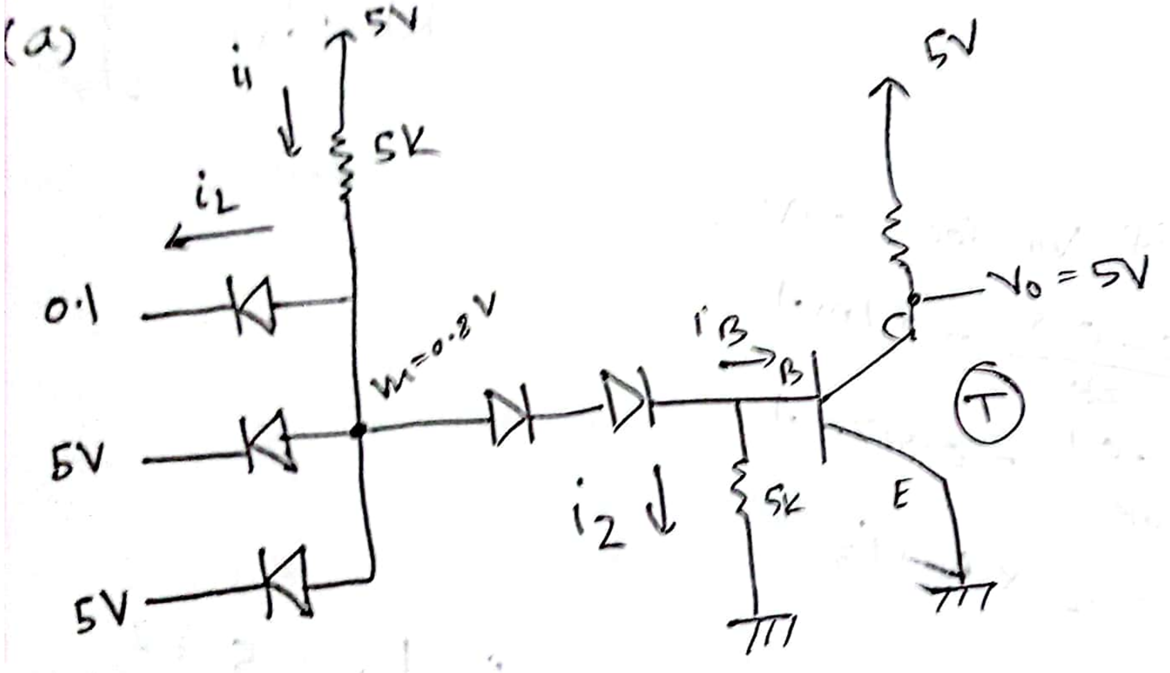
Finally Fanout of the circuit = min (14, ∞)

= 14

(Ans.)

Ans. to the question no. 03:

(a)

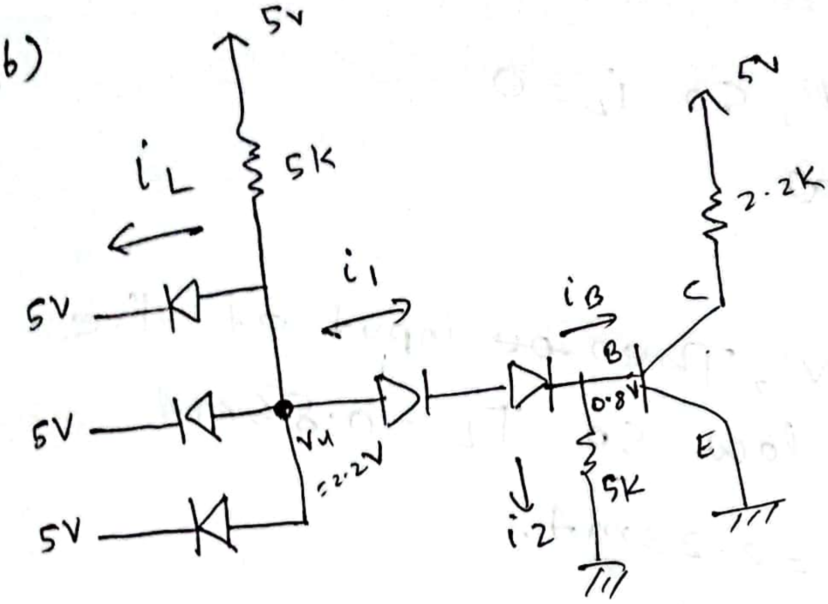


T will be in cut-off.

$\therefore i_2 = i_B = i_C = 0mA$

$\therefore i_1 = i_L = \frac{5-0.8}{5K} = 0.84mA$.

(b)



Since inputs are high, $i_L = 0$

$$\therefore i_1 = \frac{5-2.2}{5k} = 0.56\,mA$$

$$i_2 = \frac{0.8-0}{5} = 0.16\,mA$$

$$i_B = i_1 - i_2 = 0.4\,mA$$

$$i_C = \frac{5-0.1}{2.2k} = 2.23\,mA$$

c) Case 1:

$V_o = high = 5V$, so $i_L = 0$

fanout $= \infty$

Case 2:

$V_o = low = 0.1V$, Then ~~ou~~ input of the load will be low. so, $I_L = 0.84mA$

$$i_1' = \frac{5-0.1}{2.2K} = 2.23mA$$

$\therefore i_c = i_1' + i_L \times N$

$i_L \times N = 12 - 2.23$

$\therefore N = \lfloor 11.63 \rfloor = 11$

$\therefore$ fanout $= \min(\infty, 11)$

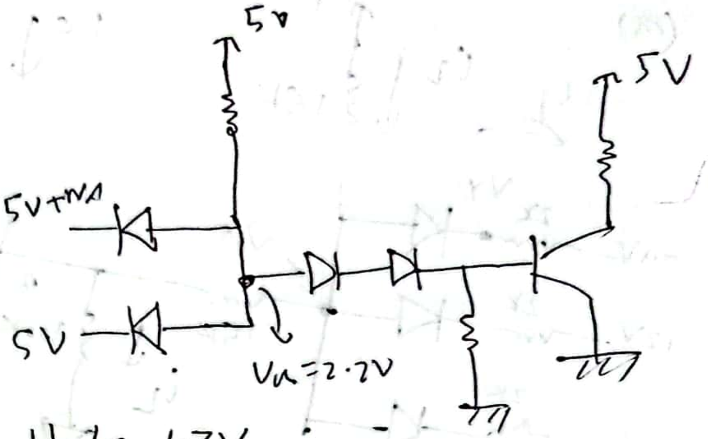
$= 11$ (Ans:)

(d) Here, inputs are high. Malfunctioning means current will flow the shown direction. To conduct V_A should be $(2.2-0.6)=1.6V$

$\therefore 5V+N=1.6V$

$\therefore N=\lfloor -3.4 \rfloor = 3.4$

Noise margin 3.4V



(e) To malfunction V_n should be 1.7V

$\therefore V_n+N=1.7$

$\therefore N=1.7-0.8=0.9V$

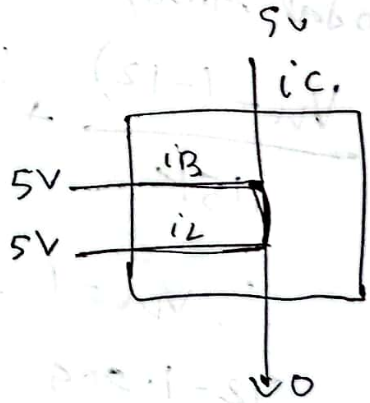
So, Noise margin $=0.9V$

(f) maximum power dissipation will happen when inputs are High. Here,

$i_2=0.16mA$

$i_B=0.4mA$

$i_L=2.23$



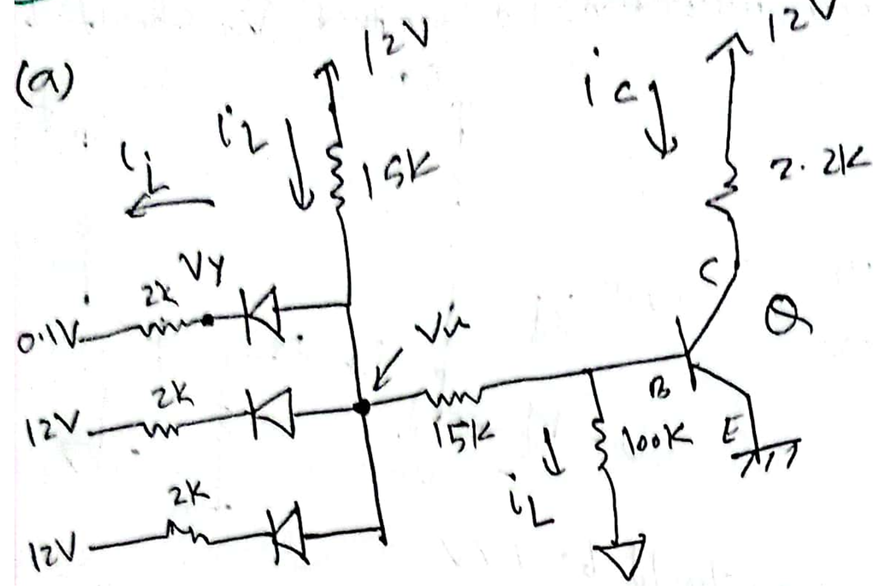
$\therefore P = P_1+P_2+P_3$

$= 5(0.16+0.4+2.23)$

$= 13.95\ m(A)$

Ans. to the question no:04:

(a)



Transistor Q will be in cutoff. So $i_B = i_C = 0\,mA$

Now, $0.7V = V_u - V_y$

$V_y = V_u - 0.7V$

Nodal Analysis at V_u,

$$\frac{V_u-(-12)}{115K} + \frac{(V_u-0.7)-0.1}{2K} + \frac{V_u-12}{15K} = 0$$

$\therefore V_u = 1.904V$

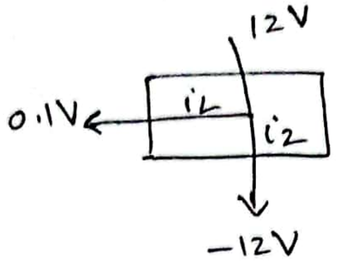
$$i_1 = \frac{12-1.904}{15K} = 0.673\,mA$$

$$i_L = \frac{V_u-0.7-0.1}{2K} = \frac{1.904-0.7-0.1}{2K}$$

$$= 0.552\,mA$$

$$i_2 = \frac{1.904+12}{115} = 0.121\,mA$$

power dissipation –



$\therefore P = i_L(12-0.1) + i_2(12+12) = 9.4728\ mW$ (Ans)

(b) Given, $A = B = C = 12V$

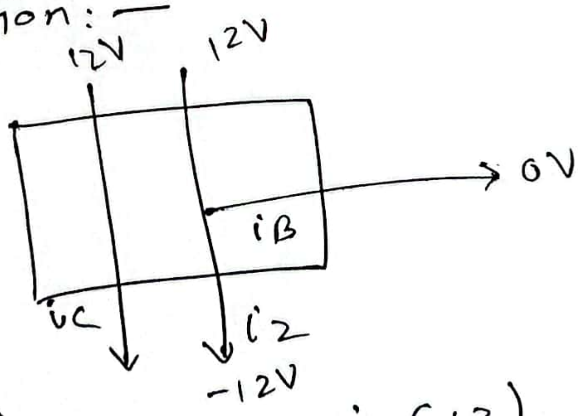
$\therefore i_1 = \frac{12-0.8}{30k} = 0.373\ mA$

$i_2 = \frac{0.8-(-12)}{100k} = 0.128\ mA$

$i_C = \frac{12-0.1}{2.2k} = 5.41\ mA$

$i_B = i_1 - i_2 = 0.245\ mA$

Power dissipation: –



$\therefore P = i_2(12+12) + i_B(12) + i_C(12)$

$= 70.932\ mW$ (Ans)