CSE 251 ASSIGNMENT 2

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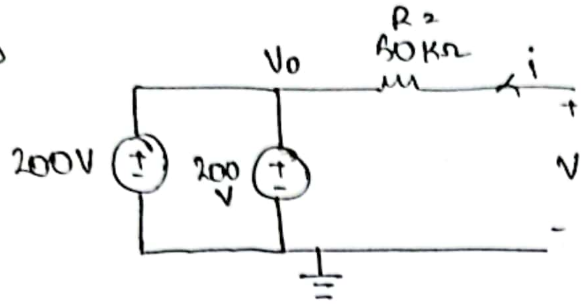
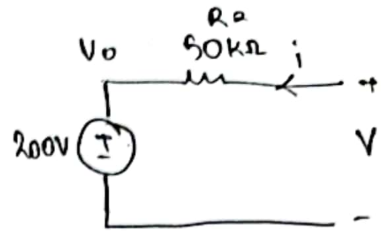
SECTION: 12

CSE 251 ASSIGNMENT 2

(1)(i)





Using KCL,

$I_2 + 200 - 200 = 0$

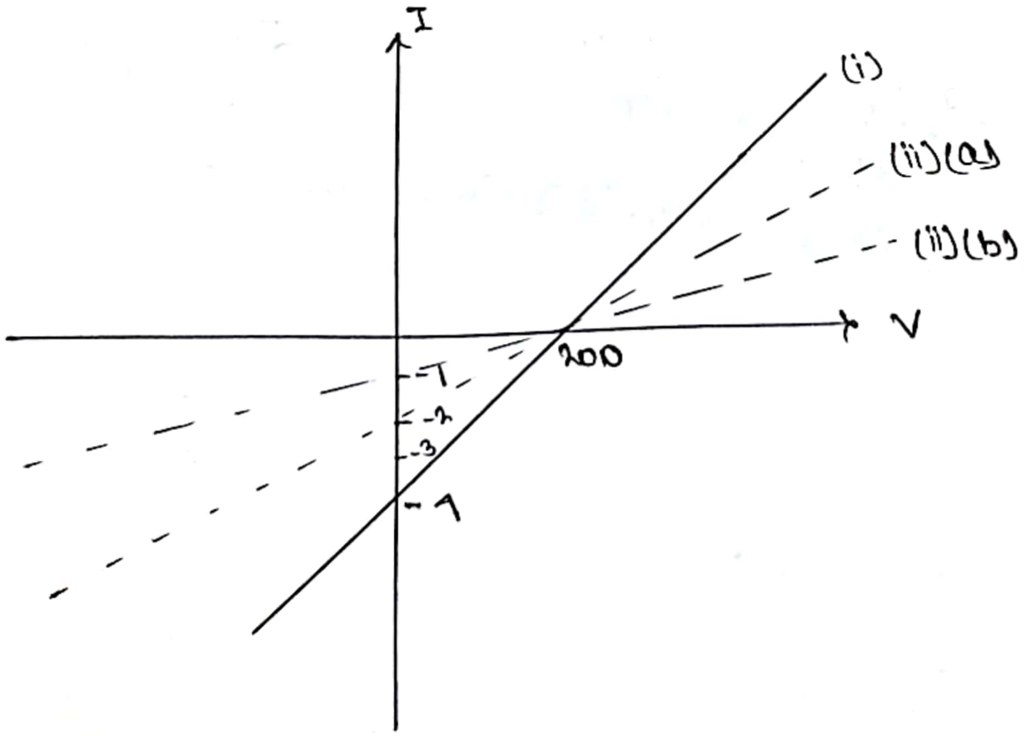
$I_2 = 0$

$50I + 200 - V = 0$

$I = \frac{V}{50} - \frac{200}{50}$ $\left[I = \frac{V}{R} - \frac{200}{R} \right]$

$I = \frac{1}{50} \cdot V - \frac{200}{50} \Rightarrow I = \left(\frac{1}{50}\right)V - 4$

$y = m \quad x + c$



At $I = 0$,

$0 = \frac{1}{50}V - \frac{200}{50}$

$V = 200\,V$

(ii) $I = \left(\frac{1}{R}\right)V - \frac{200}{R}$

y-intercept, $c = -\frac{200}{R}$
↓
I

x-intercept $\Rightarrow 0 = \left(\frac{1}{R}\right)V - \frac{200}{R}$
↓
V

$\Rightarrow \left(\frac{1}{\cancel{R}}\right)V = \frac{200}{\cancel{R}}$

$\Rightarrow V = 200$

$\therefore$ V-intercept remains constant for any change in R. That is V-intercept ~~R~~ is not dependent on R, whereas, I-intercept has the variable R in it, thus change in R, changes the I-intercept.

Slope $= \frac{1}{R}$. So, increase in R, decreases slope.

(a) $R = 100\,k\Omega$

$I = \left(\frac{1}{100}\right)V - \frac{200}{100} \Rightarrow I = \left(\frac{1}{100}\right)V - 2$

Here, R increases, so m decreases. I-intercept also changes.

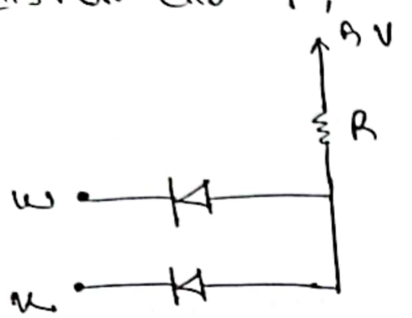
(b) $R = 200\,k\Omega$

$I = \left(\frac{1}{200}\right)V - \frac{200}{200} \Rightarrow I = \left(\frac{1}{200}\right)V - 1$

Here, R increases more than that in a, so decrease in m is more. I-intercept again changes position.

(2) Part a:

(ii) For ckt − 1,



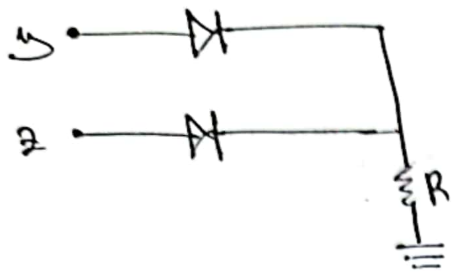
This part of the circuit gives the minimum output voltage. So, it will work like the "AND" gate.

w	x	V_{out}
0	0	0
0	1	0
1	0	0
1	1	1

Truth Table for w and x

$\therefore \min(w, x) = wx$

For ckt-2,



This part of the circuit gives the maximum voltage output. So, it will work like the "OR" gate

y	z	Vout
0	0	0
0	1	1
1	0	1
1	1	1

Truth table for y OR z

$\therefore \max(y, z) = y + z$

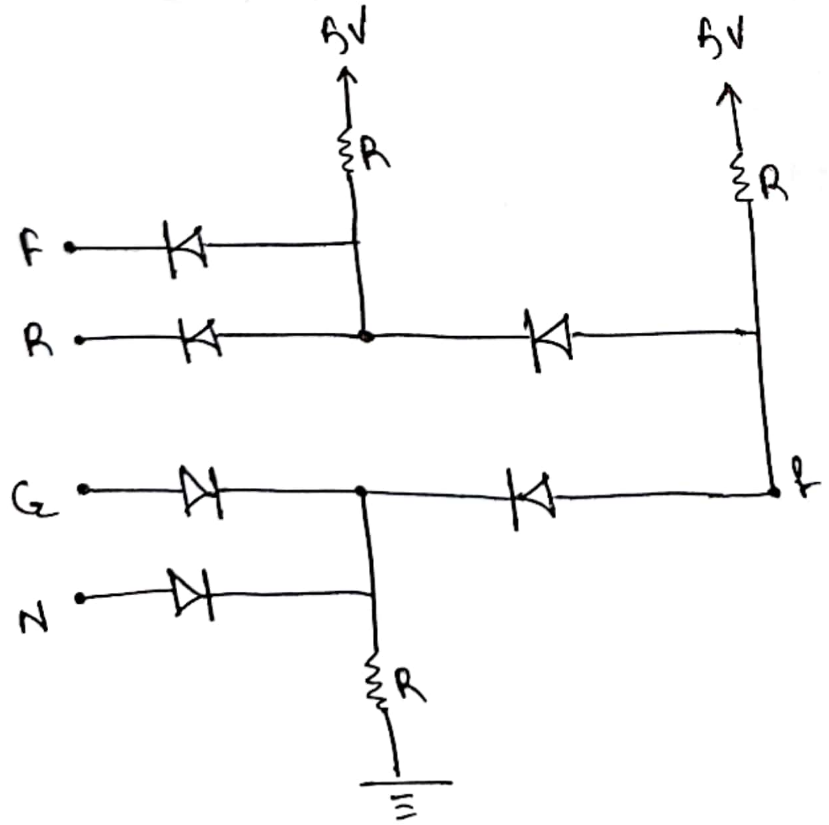
(b) ckt-1 is connected to another diode and ckt-2 is connected to a second diode, and the diodes are connected to R with 5V power supply. This gives the minimum value of f

$f = (wx)(y+z)$

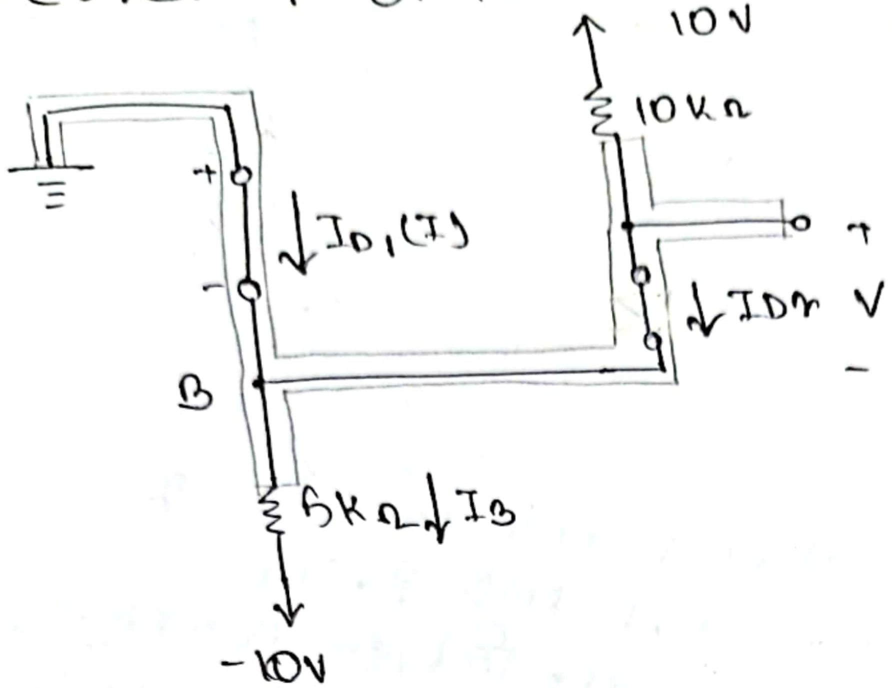
part b

(c) For the request to be considered, condition 1 and 2 need to be fulfilled at first. So, F AND R. Then condition 3 or 4 need to be fulfilled, so G OR N. Finally, condition 1 and condition together with condition 3 or 4 must be satisfied. Thus, $(FR)(G+N) = f$

(d)



(3)(i) Let D1 – ON, D2 – ON



$I_{D2} = \frac{10-0}{10} \Rightarrow I_{D2} = 1\,mA > 0\,mA$ ✓

$I_{D1} + I_{D2} = I_B$

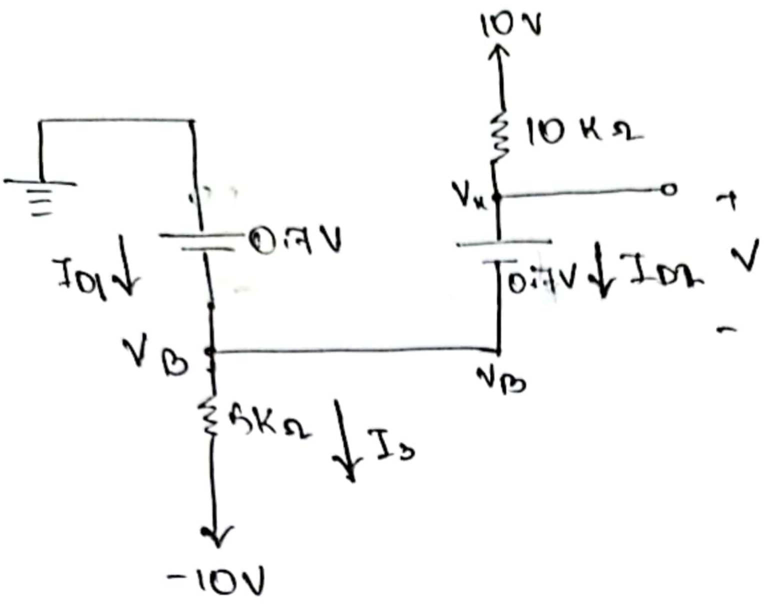
$I_{D1} = \frac{0-(-10)}{5} - 1 \Rightarrow I_{D1} = 1\,mA > 0\,mA$ ✓

∴ The assumption is correct.

$I = I_{D1} = 1\,mA$

$V = 0\,V$

(ii) Let D1 – ON, D2 – ON



$0 - V_B = 0.7$

$V_B = -0.7V$

$V_x - V_B = 0.7$

$V_x - (-0.7) = 0.7$

$V_x = 0V$

$I_{D2} = \frac{10 - V_x}{10} \Rightarrow \frac{10-0}{10} \Rightarrow I_{D2} = 1mA > 0mA$ ✓

$I_{D1} + I_{D2} = I_3$

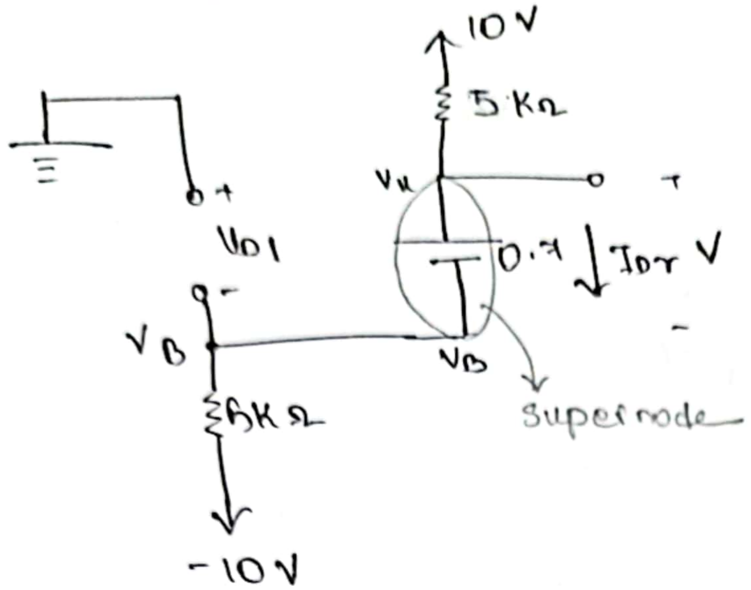
$I_{D1} = \left(\frac{-0.7-(-10)}{3}\right) - 1 \Rightarrow I_{D1} = 0.86mA > 0mA$ ✓

∴ The assumption is correct.

$I_0 = I = 0.86 mA$

$V = V_x = 0V$

(iii) Let D1 – OFF, D2 – ON



$V_x - V_B = 0.7 \Rightarrow V_x = V_B + 0.7$

$$\frac{V_B - (-10)}{5} + \frac{V_x - 10}{5} = 0$$

$$\frac{V_B + 10}{5} + \frac{(V_B + 0.7) - 10}{5} = 0$$

$V_B = -0.35\ V$

$I_{D2} = \frac{10 - (-0.35 + 0.7)}{5} \Rightarrow I_{D2} = 1.93\ mA > 0\ mA$ ✓

$V_{D1} = 0 - (-0.35) \Rightarrow V_{D1} = 0.35\ V < 0.7\ V$ ✓

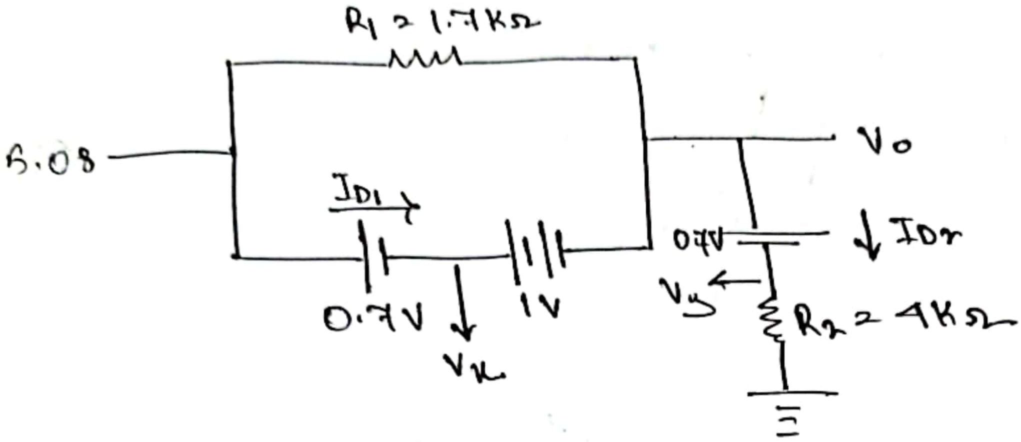
∴ The assumption is correct

$I_{D1} = I = 0\ mA$

$V = V_x = -0.35 + 0.7 = 0.35\ V$

(7) Assumption: D1 – ON, D2 – ON

$V_I = 5 + 8 \times 10^{-2} = 5.08 V$



$5.08 - V_x = 0.7 \Rightarrow V_x = 4.38 V$

$V_x - V_0 = 1 \Rightarrow V_0 = 3.38 V$

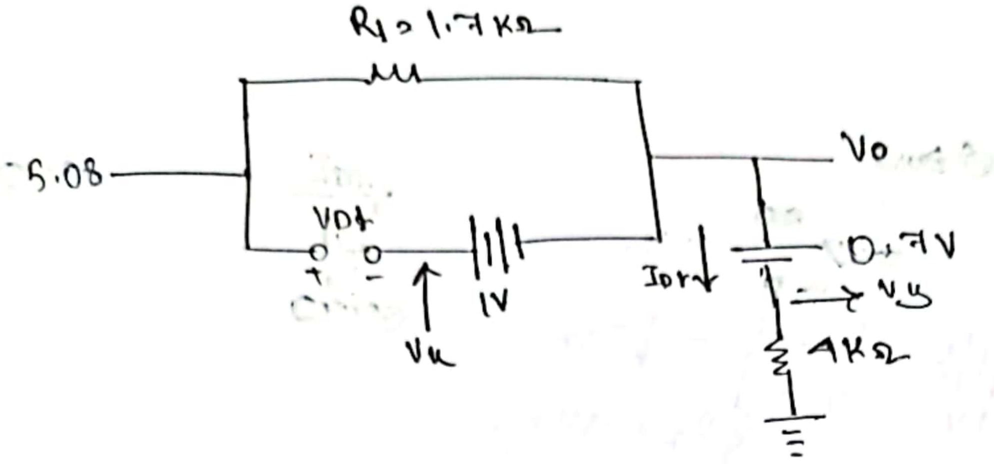
$V_0 - V_y = 0.7 \Rightarrow V_y = -4.08 V$

$I_{D1} = \frac{V_0 - 5.08}{1.7} \Rightarrow I_{D1} = \frac{-3.38 - 5.08}{1.7} \Rightarrow I_{D1} = -4.98 mA \ngtr 0 mA$

$I_{D2} = \frac{V_y - 0}{4} \Rightarrow I_{D2} = \frac{-4.08 - 0}{4} \Rightarrow I_{D2} = -1.02 mA \ngtr 0 mA$

The assumption is wrong.

Modified assumption: D1 — OFF, D2 — ON



$1.7I + V_{D1} + 1 = 0$

$1.7I + (5.08 - V_x) + 1 = 0$

$1.7I + (5.08 - (1 + V_o)) + 1 = 0$

$1.7I + 5.08 - \cancel{1} - V_o + \cancel{1} = 0$

$1.7(0) + 5.08 - V_o = 0$

$V_o = 5.08\,V$

$5.08 - V_x = V_{D1}$

$V_x - V_o = 1 \Rightarrow V_x = 1 + V_o$

$V_o - V_y = 0.7 \Rightarrow 5.08 - V_y = 0.7$

$\Rightarrow V_y = 4.38\,V$

$V_x = 1 + 5.08 = 6.08\,V$

$V_{D1} = 5.08 - V_x = 5.08 - 6.08 = -1V < 0.7\,V$ ✓

$I_{D2} = \frac{V_y - 0}{4} = \frac{4.38 - 0}{4} = 1.095\,mA > 0\,mA$

∴ The assumption is correct.

$I_{R1} = \frac{5.08 - V_o}{R_1} = \frac{5.08 - 5.08}{1.7} = 0\,mA$

$I_{D1} = 0\,mA$

$I_{D2} = 1.095\,mA$

$V_o = 5.08\,V$