Riazul Islam Rifat

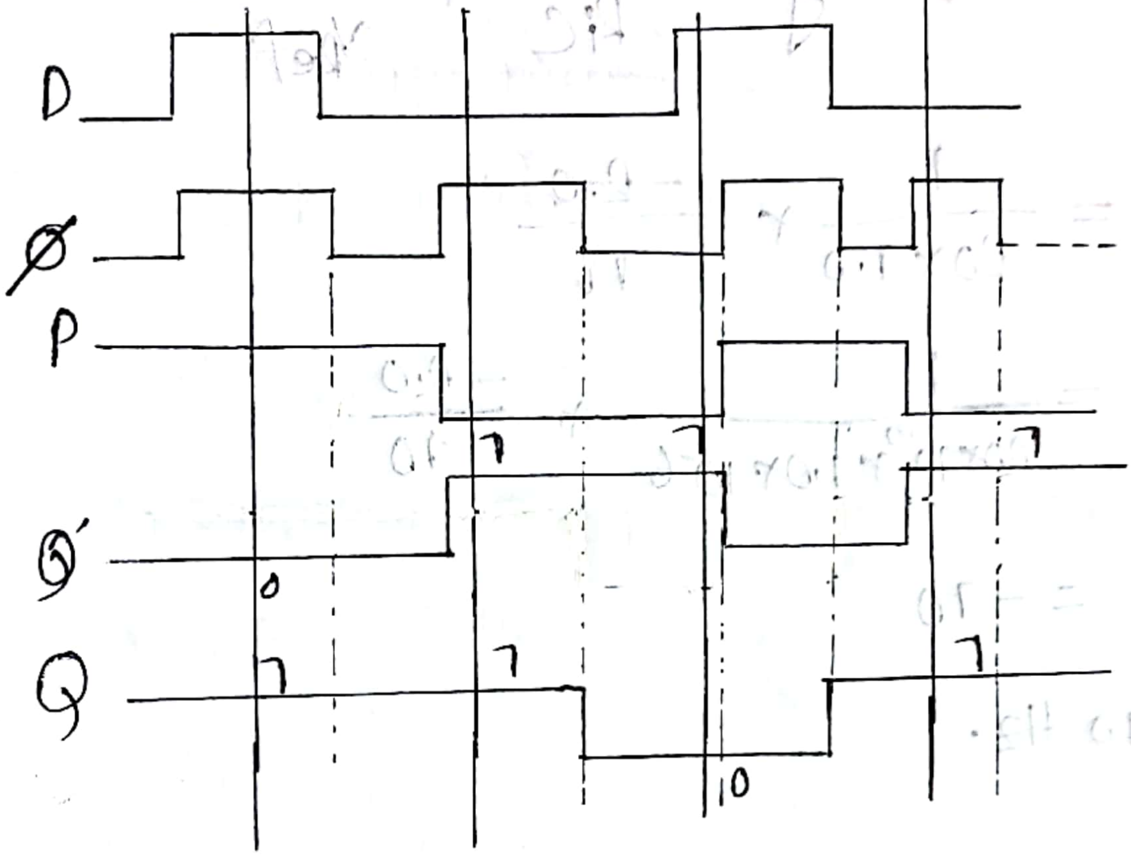
ID → 18707236

Sec → B

Final Assesment.

Ans to the Q no 1

Part 1.



Part 2

Here XNOR needs to be used.

Truth table of XNOR:

A	B	output
0	0	1
0	1	0
1	0	0
1	1	1

Part 3

We know frequency $f = \frac{1}{R_i C} \times \frac{E_i}{V_{ref}}$

$$= \frac{1}{20 \times 1.0} \times \frac{-2.0}{10}$$

$$= \frac{1}{20 \times 10^{3} \times 1.0 \times 10^{-6}} \times \frac{-2.0}{10}$$

$$= -10$$

$\therefore f = 10$ Hz.

$$T = \frac{1}{f}$$

$$= \frac{1}{10}$$

$$= 0.1\ s$$

$$= 100\ ms.$$

Ans

Part 4

We know here,

$$V_{UT} = -\left[\frac{-V_{sat} + V_f}{P}\right]$$

$$5 = -\frac{-13.8 + 0.6}{P}$$

$$\Rightarrow 5P = 13.2$$

$$\therefore P = 2.64$$

$$\therefore PR = 2.64 \times 15$$
$$= 39.6$$

We know,

$$C = \frac{P}{2R_i f}$$

$$= \frac{2.64}{15 \times 0.5 \times 10^6 \times 2}$$

Ans

Ann to the q no 2

$$I_{DL} = k_{nL}(V_{GSL} - V_{TNL})^2 = I_{DD} = k_{nD_1}\left[2(V_{GSD_1} - V_{TND_1})V_{DS_1} - V_{DS_1}^2\right] + k_{nD_2}\left[2(V_{GSD_2} - V_{TND_2})V_{DS_2} - V_{DS_2}^2\right]$$

$$\therefore 0.2(4.4 - V_0 - 1)^2 = 0.2\left[2(4.4 - 0.6)V_0 - V_0^2\right] + 0.2\left[2(4.4-1)V_0 - V_0^2\right] \quad \ldots (1)$$

From equation 1;

$V_0 = 6.47120 \rightarrow$ this in not accepted.

$= 0.59545$

$\therefore V_0 = 0.59545$

$\therefore I_{DL} = 0.2(4.4 - 0.59545 - 1)^2$

$= 1.573$

$\therefore$ Power dissipation $= 4.4 \times 1.573$

$= 6.9216.$

$\therefore I_{D1} = 0.2\left[2(4.4 - 0.6)0.59545 - (0.59545)^2\right] = 0.83477$

$\therefore I_{D2} = 1.573 - 0.83477 = 0.7388$

Ans: to the Q no 3

For Pmos, Nmos transition condition satisfies in

So,

$I_{DP} = I_{DN}$

$\Rightarrow kn(V_{GSN} - V_{TN})^2 = kp.(V_{SGP} + V_{TP})^2$

$\Rightarrow \frac{kn}{kp}(V_{GSN} - V_{TN})^2 = \frac{kp}{kp}(V_{SGP} + V_{TP})^2$

$\Rightarrow 5(V_i - 0.8)^2 = (V_{DD} - V_i - 0.8)^2$ - - - (1)

Now ~~to~~ finding V_i from this equation (1)

$V_i = 0.95450$

$= 0.39549 \rightarrow$ this is not accepted

(1)

$\therefore V_i = 0.95450 = V_{it}$.

(2)

Now transition condition for PMOS

$V_{SDP} = V_{SGD} + V_{TP}$

$\Rightarrow 2.7 - V_0 = 2.7 - V_i + V_{TP}$

$\Rightarrow V_0 = 0.95450 + 0.8$

$= 1.7545$

(3) ⇒ transition condition for NMOS:

$V_{DSN} = V_{GSN} - V_{TN}$ (2)

$\Rightarrow V_0 = V_i - 0.8$

$\therefore V_0 = 0.7545$

[ii] In V_{iL} and V_{OHU} point;

NMOS is in saturation

PMOS " " triode.

As $I_{DP} = I_{DN}$

$\therefore k_n(V_{GSN} - V_{TN})^2 = k_p\left[2(V_{SGD} + V_{TP})V_{SDP} - V_{SDP}^2\right]$

$\Rightarrow 0.2(V_i - 0.8)^2 = 0.04\left[2(2.7 - V_i - 0.8)(2.7 - V_0) - (2.7 - V_0)^2\right]$ (2)

Now assuming;

$V_i - 0.8 = x \Rightarrow \frac{d}{dV_i}(V_i - 0.8) = \frac{dx}{dV_i} = \frac{dx}{dV_i} = 1$

$2.7 - V_0 = y \Rightarrow \frac{d}{dy}(2.7 - V_0) = \frac{dy}{dy} = \frac{dV_0}{dy} = -1$

The chain rule for;

$\frac{dy}{dx} = \frac{dV_i}{dx} \cdot \frac{dV_0}{dV_i} \cdot \frac{dy}{dV_0}$

$= 1.$

using x, Y in equation 2; (m)

$$| V_P = x + 0.8$$

$$\Rightarrow 5x^2 = 2(0.5 - x)Y - Y^2$$

$$\Rightarrow 5x^2 - \cancel{4.2}Y + 2xY + Y^2 = 0 \quad \cdots \cdots (3)$$

$$\Rightarrow \frac{d}{dx}\left(5x^2 - \cancel{4.2}Y + 2xY + Y^2\right) = 0$$

$$\Rightarrow 10x + 2Y\frac{dY}{dx} + 2Y + 2x\frac{dY}{dx} - \cancel{4.2}\frac{dY}{dx} = 0$$

$$\Rightarrow 10x + 2Y + 2Y + 2x - \cancel{14.2} = 0 \quad \left(\text{using } \frac{dY}{dx} = 1\right)$$

$$\Rightarrow 12x + 4Y - \overset{1}{\cancel{4.2}} = 0$$

$$\therefore x = \left(\overset{1}{\cancel{4.2}} - 4Y\right)/12 \quad \cdots \cdots (4)$$

$$= \overset{0.083}{\cancel{0.35}} - \frac{1}{3}Y$$

using x in equation 3;

$$Y = \overset{1.21767}{\cancel{5.71529}} \rightarrow \text{this is out of range.}$$

$$= \cancel{0.73470}\ 0.03182$$

$$\therefore Y = \cancel{0.73470}\ 0.03182$$

$$\therefore V_O = \underset{2.06878}{\cancel{1.9653}} = V_{OH}$$

using Y in equation (4)

$$x = \cancel{0.30509}\ 0.07239$$

$$\therefore V_{IL} = \cancel{1.10509}\ 0.87239$$

7) $\Rightarrow$ PMOS in triode region when V_{IL} in input and V_{OHU} in output. (4)

8) $\Rightarrow$ NMOS in in saturation. (4)

9) $i_{DN} = 0.2(0.87239 - 0.8)^2$

$= 1.048 \cancel{110}\ \mu A$.

10) Power dissipation 2.1×1.048

$= 2.2009 \mu W$.

Ans

Ans to the Q no 4

Here

$$I_R = I_{D1} + I_{D2} \quad (1)$$

$$I_R = \frac{V_{DD} - V_o}{R_D}$$

For $V_1 = V_2 = 4.250$, let's mosfet will be in triode.

$$\therefore I_{D1} = k_n [2(V_{GS} - V_{TN1})V_{DS} - V_{DS}^2]$$

$$= 0.2[2(4.250 - 0.8)V_o - V_o^2]$$

$$\therefore I_{D2} = k_n [2(V_{GS} - V_{TN2})V_{DS} - V_{DS}^2]$$

$$= 0.2[2(4.250 - 1)V_o - V_o^2]$$

$\therefore I_R = I_{D1} + I_{D}$, from this equation we get,

$V_o = 0.36580$

$6.83419 \longrightarrow$ this is not possible.

$\therefore$ So $V_o = 0.36580$.

Using $V_0 = 0.36580$

$$I_R = \frac{5 - 0.36580}{5}$$

$$= 0.92684 mA$$

$\therefore I_{D1} = 0.4780 mA$ (using TN_1)

$\therefore I_{D2} = 0.4488 mA$ (using TN_2)

$\therefore$ Power dissipation $= \Delta V I$

$$= (V_{DD} - 0) I_R$$

$$= 4.634 mW.$$

Now assuming $V_2 = 0V$, M_2 will be off. M_1 in triode.

The transition condition is:

$$\Rightarrow V_{DS} = V_{GS} - V_{TN}$$

$$\cancel{V_D - V_S = 4.250 - 0.8}$$

$$\cancel{V_0 - 0 = 3.45}$$

$$\cancel{\therefore V_0 = 3.45}$$

$$\Rightarrow V_0 = V_G + V_T$$

$$\Rightarrow V_G = V_0 + V_T.$$

Scanned with CamScanner

As M_2 is off so $I_{D2} = 0$.

(a)

$\therefore I_{R_B} = I_{D1} = \frac{5 - V_0}{5}$

$\therefore \frac{5 - V_0}{5} = 0.2(V_0 + 0.8 - 0.8)^2$

$\therefore V_0 = -2.79$ (Not accepted)

$= 1.79128$

$\therefore V_0 = 1.79128.$

Transition condition:

$V_{DS} = V_{GS} - V_{TN}$

$\Rightarrow 1.79128 = V_G - 0.8$

$\therefore V_G = 2.59128 = V_1.$

7 ⇒ if input voltagen are not zero;

here,

$$V_0 = V_1 - TN_1$$

$$V_0 = V_2 - TN_2$$

$I_R = I_{D_1} + I_{D_2}$

$$\frac{5 - V_0}{5} = 0.2\{V_0\}^2 + 0.2\{V_0\}^2$$

$\therefore V_0 = 1.35078$

$= -7.85078$ (Not accepted)

$\therefore V_0 = 1.35078$

8 → $V_0 = V_1 - TN_1$

$1.350 = V_1 - 0.8$

$\therefore V_1 = 2.15078$

9 → $V_0 = V_2 - TN2$

$\therefore V_2 = V_0 + TN_2$

$= 2.35078$

10 → $I_R = \frac{5 - V_0}{5}$

$= 0.729844.$

Ans