Assignment

Name: Aditi Rout
Registration No: B120003

Q1. $(-17)_{10}$

i) In sign magnitude: 101001

$$\begin{array}{r|l} 2 & 17 - 1 \\ 2 & 8 - 0 \\ 2 & 4 - 0 \\ 2 & 2 - 1 \\ & 1 \end{array}$$

ii) one's complement → 010111

iii) two's complement → 010111 + 1

= 011000

Q2.

−48 → 1001111 + 1 = 1010000

−23 → 101000 + 1 = 101001

−48 − 23 = 1010000

$$\begin{array}{r} 1010000 \\ +\ 101001 \\ \hline \cancel{0}\ 1111001 \end{array}$$

~~discarded~~

Ans : ~~11001~~ 1111001 (Ans)

Q3 a) ~~0110 → $2^2+2^1 = 6$~~
~~0111 → $2^2+2^1+2^0 = 7$.~~

so distance between BCD digits is

0110 ⊕ 0111 = 0001

it contains one only therefore the distance betn the codes are 1.

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b) In 0110.

$M = 4$.

length of hamming code $= M + P$.

$2^P \geq P + M + 1$.

$\Rightarrow 2^P \geq P + 5$

$\Rightarrow \boxed{P = 3}$

so length $= 3 + 4 = 7$.

bit position:	7	6	5	4	3	2	1
	M_4	M_3	M_2	P_3	M_1	P_2	P_1
	0	1	1	2^2	0	2^1	2^0

111	110	101	100	011	010	001
7	6	5	4	3	2	1

For P_1, we have to take bit position where LSB is 0 i.e take bit 3, 5, 7.

so we get.

$M_4 \ M_2 \ M_1 = 010$ = odd no. of ones

so $P_1 = 1$.

similary for P_2, take bit. 3, 6, 7.

$M_4 M_3 M_1 = 010$

so $P_2 = 1$

for P_3, take bit 5, 6, 7.

$M_4 M_3 M_2 = 011$ = even no. of ones.

so $P_3 = 0$.

so Hamming code: 0110011

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In 0111

$M = 4$, $P = 3$.

bit position: 7 6 5 4 3 2 1

M_4 M_3 M_2 P_3 M_1 P_2 P_1

0 1 1 2^2 1 2^1 2^0

For P_1 , take, check 3, 5, 7 in posⁿ.

$M_4 M_2 M_1$ = 0 1 1 = even no. of ones.

so $P_1 = 0$

For P_2 , check 3, 6, 7 in posⁿ.

$M_4 M_3 M_1$ = 0 1 1 = even no. of ones.

so $P_2 = 0$

For P_3, check 5, 6, 7 in posⁿ.

$M_4 M_3 M_2$ = 0 1 1 = even no. of ons.

so $P_3 = 0$.

Hamming code is: 0 1 1 0 1 0 0

So now distance betⁿ both hamming codes are: $0110011 \oplus 0110100$

$= 0000111$

so difference is $2^2 + 2^1 + 2^0 = 7$ (Ans)

Q4) Given no : 4096

i) Binary code : $(1000000000000)_2$

2 | 4096 - 0	2 | 64 - 0
2 | 2048 - 0	2 | 32 - 0
2 | 1024 - 0	2 | 16 - 0
2 | 512 - 0	2 | 8 - 0
2 | 256	2 | 4 - 0
2 | 128 - 0	2 | 2 - 0
64	1

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(ii) BCD code : 0100 0000 1001 0110

(iii) Excess - 3 code :

$$\begin{array}{cccc} 4 & 0 & 9 & 6 \\ +3 & +3 & +3 & +3 \\ 7 & 3 & 12 & 18 \\ (0111) & (0011) & (1100) & (10010) \end{array}$$

So Ans : (0111 0011 1100 10010)

(iv) Octal code : 1000

$$\begin{array}{r|l} 8 & 4096 - 0 \\ 8 & 512 - 0 \\ 8 & 64 - 0 \\ 8 & 8 \rightarrow 1 \\ & 1 \end{array}$$

(v) Hex code : $(1000)_{16}$

Q5.

CD \ AB	00	01	11	10
00	1			1
01	1			1
11	1	1	1	1
10				

$\bar{A}\bar{B}\bar{C}$ $A\bar{B}\bar{C}$ CD

So

$$Y = CD + A\bar{B}\bar{C} + \bar{A}\bar{B}\bar{C}$$
$$= CD + \bar{B}\bar{C}(A + \bar{A})$$
$$= CD + \bar{B}\bar{C}$$

Q6. a) $f(A, B, C, D) = \Sigma m(0, 1, 2, 3, 5, 7, 8, 9, 11, 14)$

CD \ AB	00	01	11	10
00	1			1
01	1	1		1
11	1	1		1
10	1		1	

So $Y = \bar{C}A\bar{B} + \bar{A}\bar{B} + \bar{A}BD + \bar{A}CD + C\bar{D}$

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b) $f(A,B,C,D) = \sum m(1,3,7,11,15) + d(0,2,5)$

CD \ AB	00	01	11	10
00	0 X	4	12	8
01	1 1	5 X	13	9
11	3 1	7 1	15 1	11 1
10	2 X	6	14	10

So

$Y = \bar{A}\bar{C}D + CD$

Q7. Design of BCD to Excess - 3 code converter circuit.

A	B	C	D	W	X	Y	Z
0	0	0	0	0	0	1	1
0	0	0	1	0	1	0	0
0	0	1	0	0	1	0	1
0	0	1	1	0	1	1	0
0	1	0	0	0	1	1	1
0	1	0	1	1	0	0	0
0	1	1	0	1	0	0	1
0	1	1	1	1	0	1	0
1	0	0	0	1	0	1	1
1	0	0	1	1	1	0	0
1	0	1	0	X	X	X	X
1	0	1	1	X	X	X	X
1	1	0	0	X	X	X	X
1	1	0	1	X	X	X	X
1	1	1	0	X	X	X	X
1	1	1	1	X	X	X	X

(A B C D: BCD Code (Input); W X Y Z: Excess - 3 Code (Output))

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AB \ CD	00	01	11	10
00	0	0	0	0
01	0	1	1	1
11	X	X	X	X
10	1	1	X	X

BC, BD, A

K-map for W.

AB \ CD	00	01	11	10
00	1	0	1	0
01	1	0	1	0
11	X	X	X	X
10	1	0	X	X

CD, $\overline{C}\overline{D}$

K-map for Y.

AB \ CD	00	01	11	10
00	1	0	0	1
01	1	0	0	1
11	X	X	X	X
10	1	0	X	X

so now

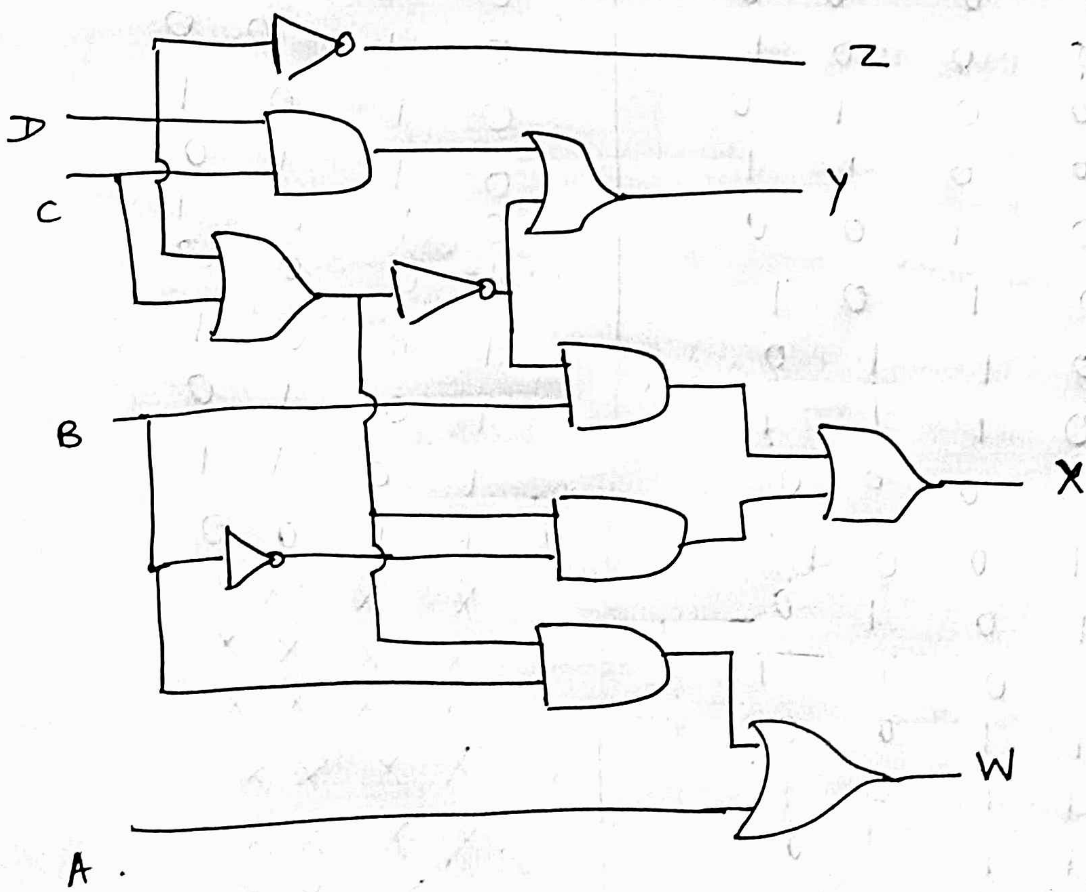
$W = A + BC + BD$

$X = \overline{B}C + \overline{B}D + B\overline{C}\overline{D}$

$Y = CD + \overline{C}\overline{D}$

$Z = \overline{D}$

so circuit diagram is:



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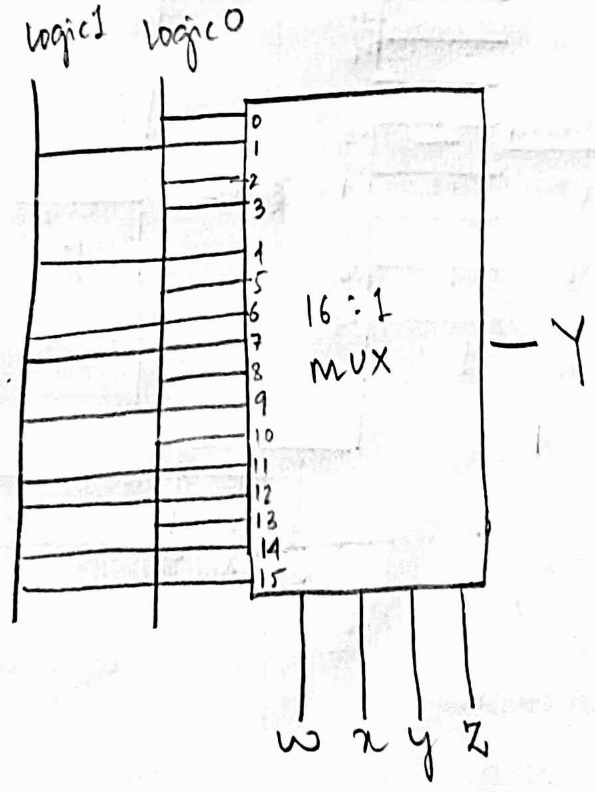
Q8. given : $f(w, x, y, z) = \sum m(1, 4, 6, 7, 9, 11, 12, 14, 1$

	w	x	y	z	F
(0)	0	0	0	0	0
(1)	0	0	0	1	1
(2)	0	0	1	0	0
(3)	0	0	1	1	0
(4)	0	1	0	0	1
(5)	0	1	0	1	0
(6)	0	1	1	0	1
(7)	0	1	1	1	1
(8)	1	0	0	0	0
(9)	1	0	0	1	1
(10)	1	0	1	0	0
(11)	1	0	1	1	1
(12)	1	1	0	0	1
(13)	1	1	0	1	0
(14)	1	1	1	0	1
(15)	1	1	1	1	1

a)



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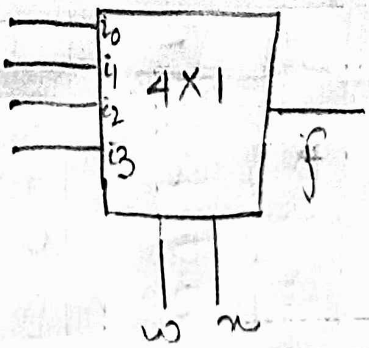
wx \ yz	00	01	11	10
00	0	1: 1	3	2
01	4: 1	5	7: 1	6: 1
11	12: 1	13	15: 1	14: 1
10	8	9: 1	11: 1	10

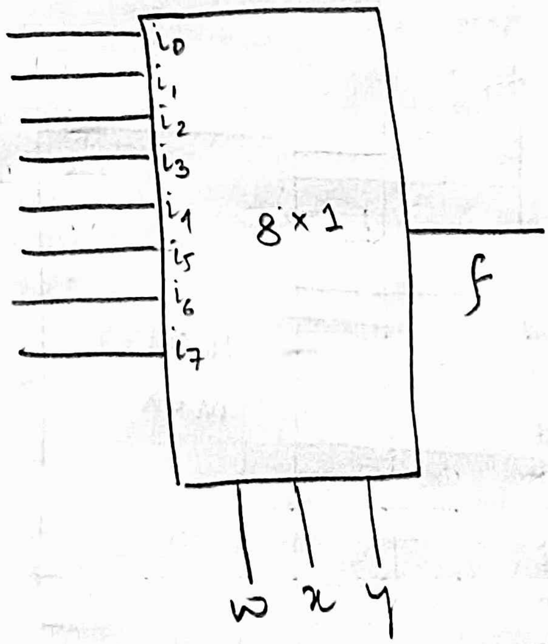
a)

w	x	Y
0	0	$z\bar{y} = i_0$
0	1	$\bar{y}z + y = i_1$
1	0	$\bar{y}\bar{z} + y = i_2$
1	1	$z = i_3$



b)

w	x	y	Y
0	0	0	$i_0 = z$
0	0	1	$i_1 = 0$
0	1	0	$i_2 = \bar{z}$
0	1	1	$i_3 = z + \bar{z} = 1$
1	0	0	$i_4 = \bar{z}$
1	0	1	$i_5 = z$
1	1	0	$i_6 = \bar{z}$
1	1	1	$i_7 = z + \bar{z} = 1$.



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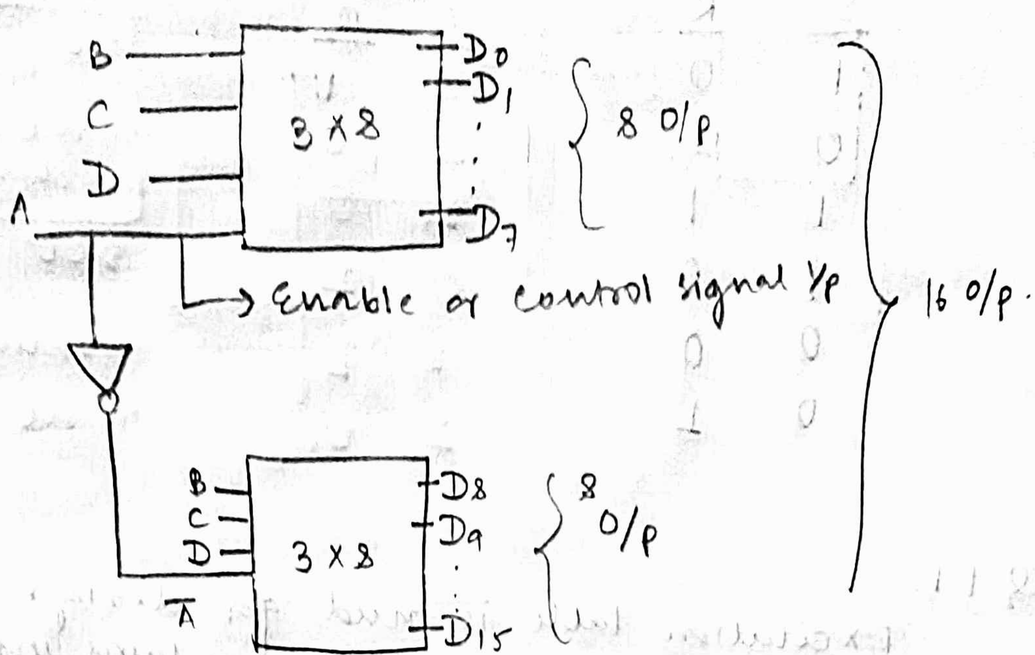
Q9.

a) 4 x 16 Decoder by using 3 x 8 decoder:

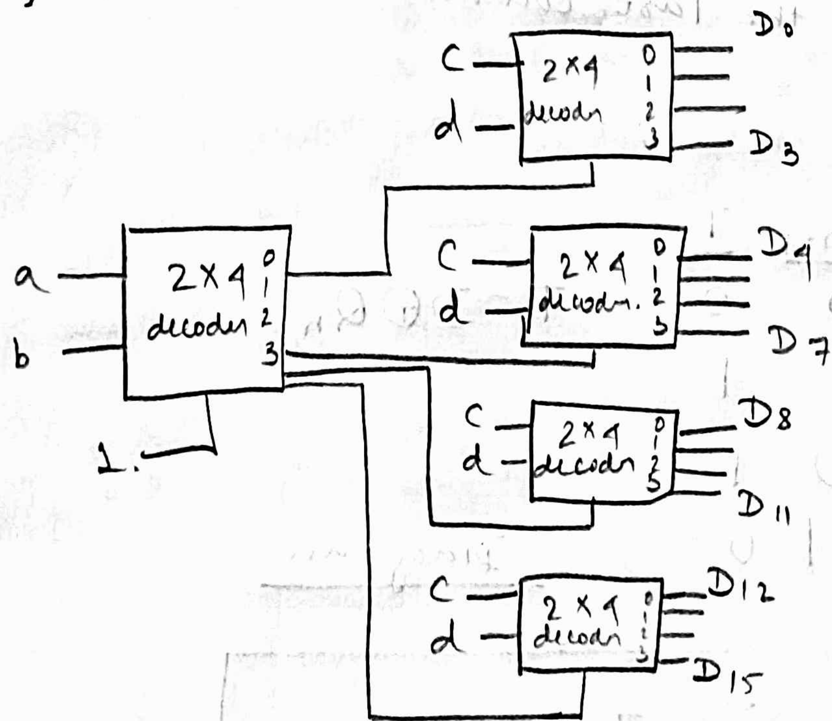


when,

A = 0 , 1st 3 x 8 decoder will operate $(D_0 - D_7) \rightarrow$ O/P

A = 1 , 2nd 3x8 decoder will operate $(D_8 - D_{15}) \rightarrow$ O/P

b) 4 x 16 line decoder using 2x4 line decoder:



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Q 10.

S	R	Outputs Q	$\bar{Q}$	Comments
1	0	0	1	set
0	1	1	0	reset.
1	1	1	0	no change
1	0	0	1	set
0	0	1	1	invalid condition.
0	1	1	0	reset.

Q 11.

Excitation table is used for design of flip-flop & counters. Truth table contains inputs & excitation table takes outputs as inputs.

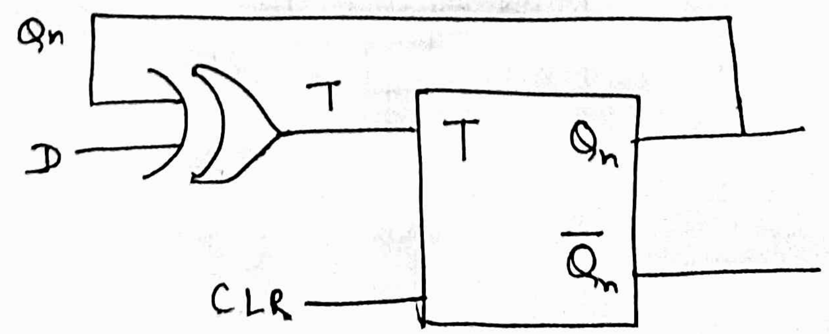
A characteristic table has the control input (D or T) as the first column, the current state as the middle column, & the next state as the last column.

Q12.

Q_n	D	Q_{n+1}	T
0	0	0	0
0	1	1	1
1	0	0	1
1	1	1	0

$T = D \oplus Q_n$.

Diagram.



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Q13. " Preset " ~~means to~~ refer to forcing an output stage to a logical " 1 "

" Clear " refer to forcing an output stage to a logical " 0 ".

Q14.

No. of states, N = 7 , Range : 0 − (7 − 1) = 0 − 6

No. of FF = $N < 2^n$ so $n = 3$

Present			Next			I/p of FF			
Q_A	Q_B	Q_C	Q_{A+1}	Q_{B+1}	Q_{C+1}	T_A	T_B	T_C	
0	0	0	0	0	1	0	1	1	(6)
0	0	1	0	1	0	0	0	1	(5)
0	1	0	0	1	1	1	1	1	(4)
0	1	1	1	0	0	0	0	1	(3)
1	0	0	1	0	1	0	1	1	(2)
1	0	1	1	1	0	0	0	1	(1)
1	1	0	0	0	0	1	1	0	(0)
1	1	1	X	X	X	X	X	X	(7)

A B C

↑ MSB ↑ LSB.

$T_A = \sum_m (4, 0) + d(7)$

$T_B = \sum m(6, 4, 2, 0) + d(7)$

$T_C = \sum m(6, 5, 4, 3, 2, 1) + d(7)$

Q_A \ Q_BQ_C	00	01	11	10
0	1			
1	1		X	

Q_A \ Q_BQ_C	00	01	11	10
0	1			1
1	1		X	1

Q_A \ Q_BQ_C	00	01	11	10
0		1	1	1
1	1	1	X	1

so $T_A = \overline{Q_B}\,\overline{Q_C}$

$T_B = \overline{Q_C}$

$T_C = Q_A + Q_C + Q_B$

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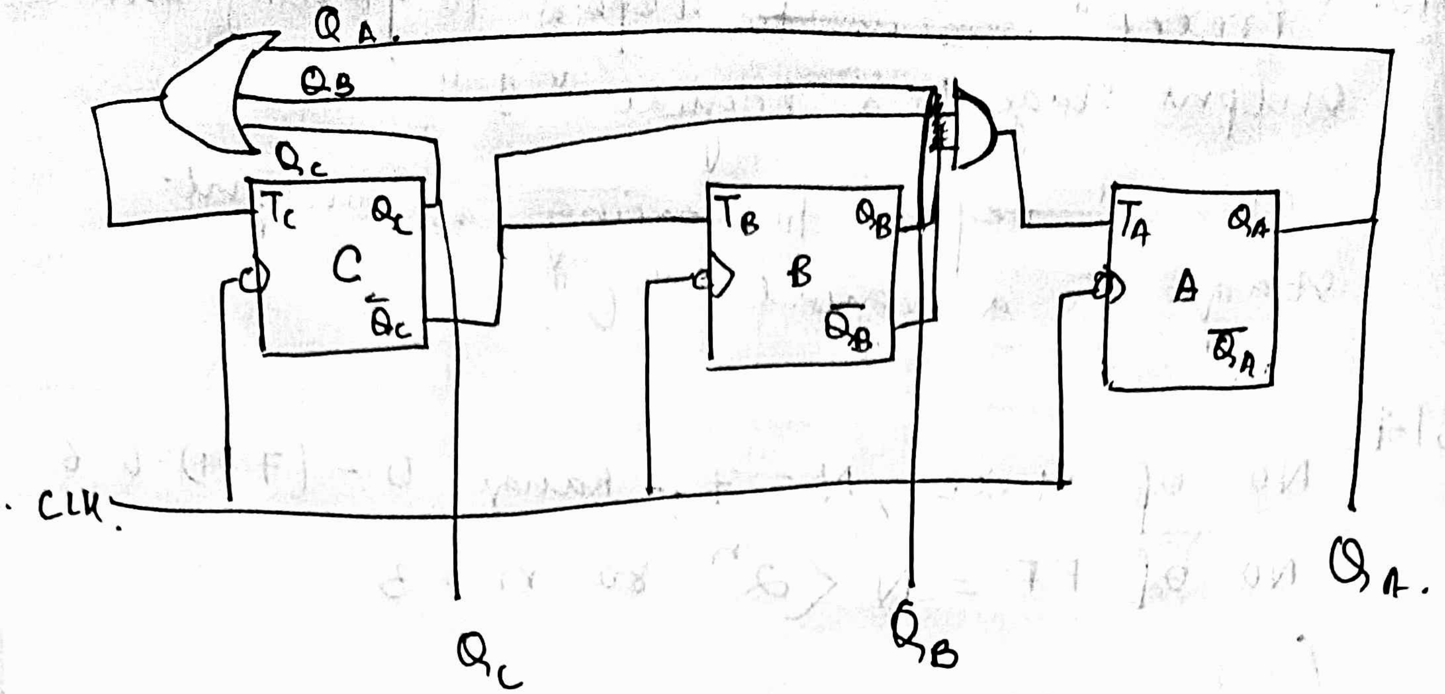

Q15. $n = 5$ = no. of bits. $(T_C = 2\ \mu s)$

a) In SISO, total delay: $(2(5) - 1)\ T_C$
$= 9 \times 2 = 18\ \mu s$

b) In SIPO, total delay $= 5 \times 2 = 10\ \mu s$

c) In PISO, total delay $= (5 - 1) \times 2 = 8\ \mu s$.