

JANUARY 2021 [CST]SUBJECT: DIGITAL LOGIC [CS2102]

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Q1) a)  $22 - 17$ 

$$(22)_{10} \rightarrow (010110)_2$$

$$(17)_{10} \rightarrow (010001)_2$$

$$(-17)_{10} \rightarrow 101110 + 000001 = (101111)_2$$

$$\begin{array}{r} 22 - 17 \Rightarrow \quad 010110 \\ \quad \quad \quad + 101111 \\ \hline \text{(carry)} \quad 000101 \end{array}$$

→ carry generated, discard it, no. is +ve

$$\therefore 22 - 17 = (0101)_2 \rightarrow (5)_{10}$$

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b) Input A, B, C

$Y = 1 \rightarrow B = C = 1, A = X$   
 $\rightarrow A = C = 0, B = X$   
 $\rightarrow A = B = C = 1$   
 $\rightarrow A = B = C = 0$

So the Truth Table will be

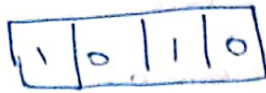
A	B	C	Y
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	0
1	1	1	1

making K-Map

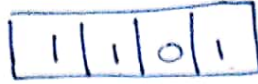
BC	00	01	11	10
A=0	1		1	1
A=1			1	

$$F(A, B, C) = A'C' + BC$$

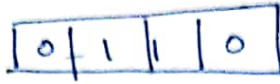
1) c) Clock 0



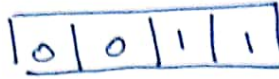
Clock 1



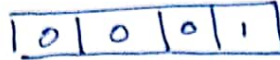
Clock 2



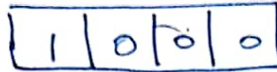
Clock 3



Clock 4



Clock 5



Clock 6



Clock 7

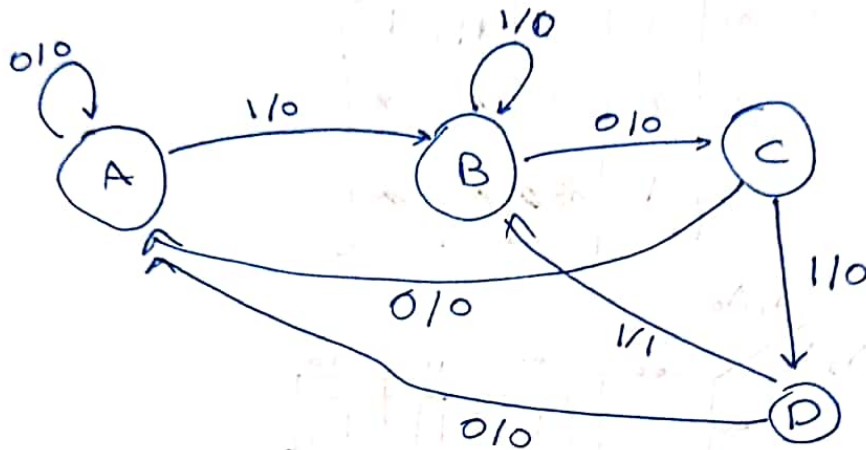


∴ after 7 clock pulses the content of shift register become 1010

3)

Eg. In: 1010101101010110110  
 Out: 0000000010000000100010

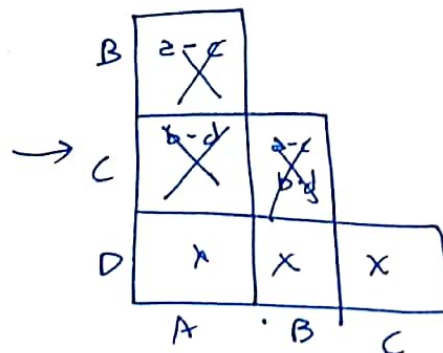
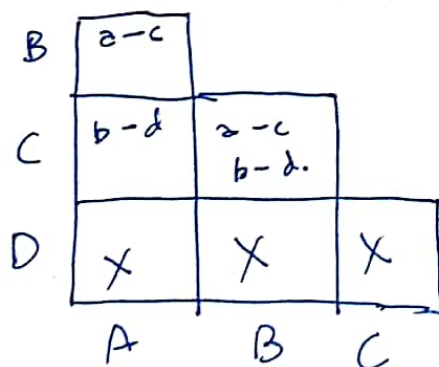
01011



state table.

Present state	Next Step / output	
	0	1
A	A / 0	B / 0
B	C / 0	B / 0
C	A / 0	D / 0
D	A / 0	B / 1

Checking for copy states



∴ no copy states

Q<sub>0</sub>)

I	PS			NS			J <sub>2</sub> K <sub>2</sub>	J <sub>1</sub> K <sub>1</sub>	J <sub>0</sub> K <sub>0</sub>	O
	Q <sub>2</sub>	Q <sub>1</sub>	Q <sub>0</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>				
0	0	0	0	0	1	1	0 x	1 x	1 x	0
0	0	0	1	0	0	1	0 x	0 x	x 0	0
0	0	1	0	0	1	0	0 x	x 0	0 x	0
0	0	1	1	0	0	1	0 x	x 1	x 0	0
0	1	0	0	0	1	0	x 1	1 x	0 x	0
0	1	0	1	<del>0</del> 0	0	0	x 1	0 x	x 1	x
0	1	1	0	0	0	0	x 1	x 1	0 x	x
0	1	1	1	0	0	0	x 1	x 1	x 1	x
1	0	0	0	1	0	0	1 x	0 x	0 x	1
1	0	0	1	1	0	0	1 x	0 x	x 1	1
1	0	1	0	0	0	0	0 x	x 1	0 x	1
1	0	1	1	0	1	0	0 x	x 0	x 1	1
1	1	0	0	0	1	1	x 1	1 x	1 x	0
1	1	0	1	0	0	0	x 1	0 x	x 1	x
1	1	1	0	0	0	0	x 1	x 1	0 x	x
1	1	1	1	0	0	0	x 1	x 1	x 1	x

→ assumed unused state resets to 000

J<sub>2</sub>

Q <sub>2</sub> Q <sub>0</sub>	I <sub>2</sub>			
	00	01	11	10
00				
01	x	x	x	x
11	x	x	x	x
10	1	1		

$$J_2 = I Q_1'$$

$$K_2 = 1$$

J<sub>1</sub>

Q <sub>2</sub> Q <sub>0</sub>	I <sub>2</sub>			
	00	01	11	10
00	<del>1</del>	<del>1</del>	x	x
01	1		x	x
11	1		x	x
10			x	x

$$J_1 = I' Q_0' + Q_2 Q_0'$$

P.S



K<sub>1</sub>

		Q <sub>1</sub> Q <sub>0</sub>			
	IQ <sub>2</sub>	00	01	11	10
00		X	X	1	*
01		X	X	1	*
11		X	X	1	1
10		X	X		1

$$K_1 = Q_2 + I'Q_0 + IQ_0'$$

J<sub>0</sub>

		Q <sub>1</sub> Q <sub>0</sub>			
	IQ <sub>2</sub>	00	01	11	10
00		1	X	X	
01			X	X	
11		1	X	X	
10			X	X	

$$J_0 = I'Q_2'Q_1' + IQ_2Q_1'$$

K<sub>0</sub>

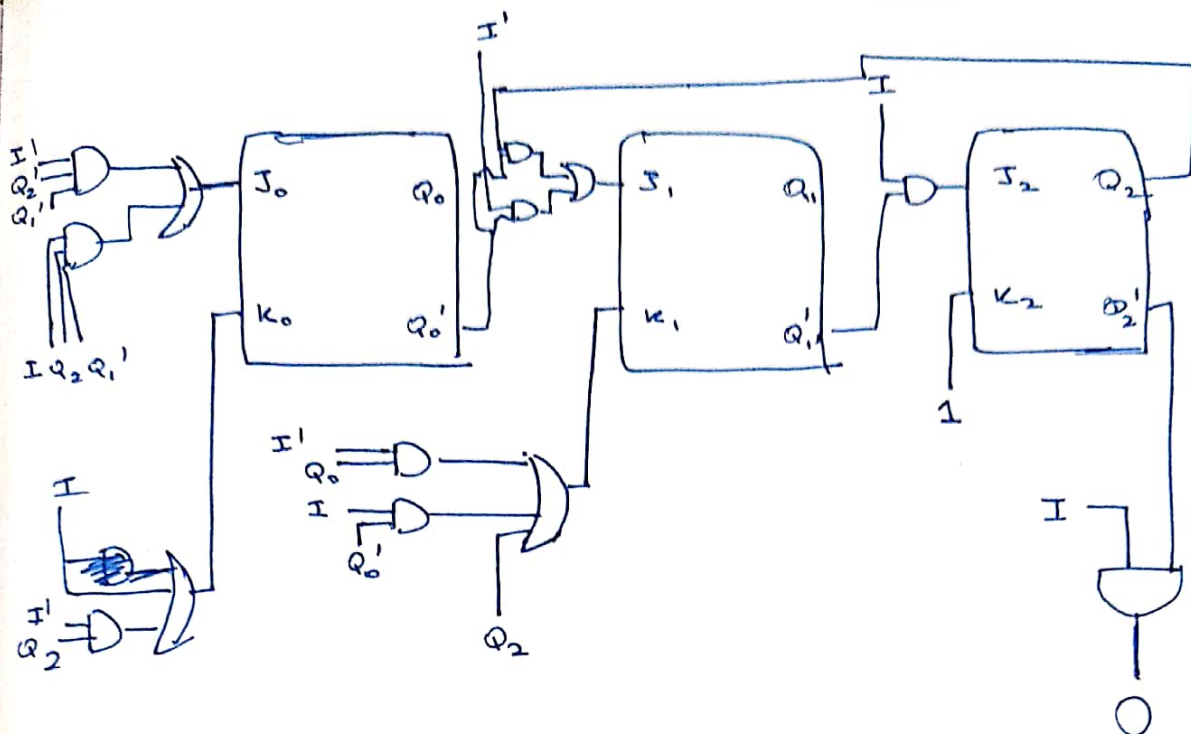
		Q <sub>1</sub> Q <sub>0</sub>			
	IQ <sub>2</sub>	00	01	11	10
00		X			X
01		X	1	1	X
11		X	1	1	X
10		X	1	1	X

$$K_0 = I + I'Q_2'$$

0

		Q <sub>1</sub> Q <sub>0</sub>			
	IQ <sub>2</sub>	00	01	11	10
00					
01			X	X	X
11			X	X	X
10					

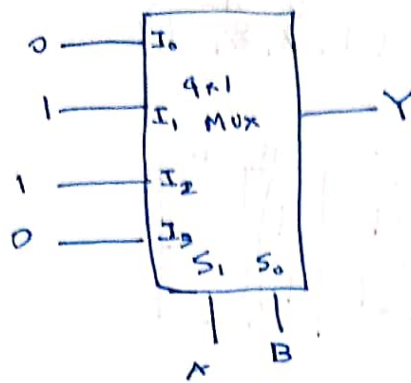
$$0 = I'Q_2'$$



Q2)

$A_3$	$A_2$	$A_1$	$A_0$	$B_3$	$B_2$	$B_1$	$B_0$
0	0	0	0	0	0	0	0
0	0	0	1	1	1	1	1
0	0	1	0	1	1	1	0
0	0	1	1	1	1	0	1
0	1	0	0	1	1	0	0
0	1	0	1	1	0	1	1
0	1	1	0	1	0	1	0

Q4) 2) I)

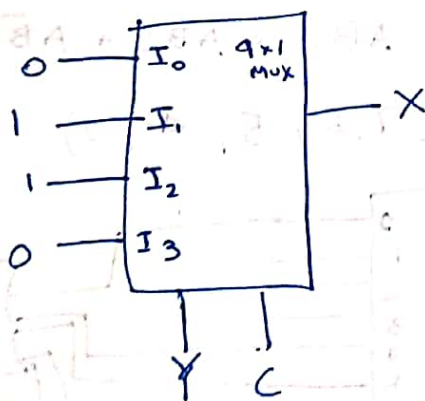


Making Truth Table

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	0

$$\therefore Y = A'B + AB'$$

II)



Making Truth Table (same as before)

$$\begin{aligned} X &= Y'C + YC' \\ &= [A'B + AB']'C + (A'B + AB')C' \\ &= [(A+B) \cdot (A'+B')]C + A'B'C' + AB'C' \\ &= ABC + A'B'C + A'B'C' + AB'C' \end{aligned}$$

$$X = \Sigma(7, 1, 2, 4)$$

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making K-Map

$$X(A, B, C) = \sum (1, 2, 4, 7)$$

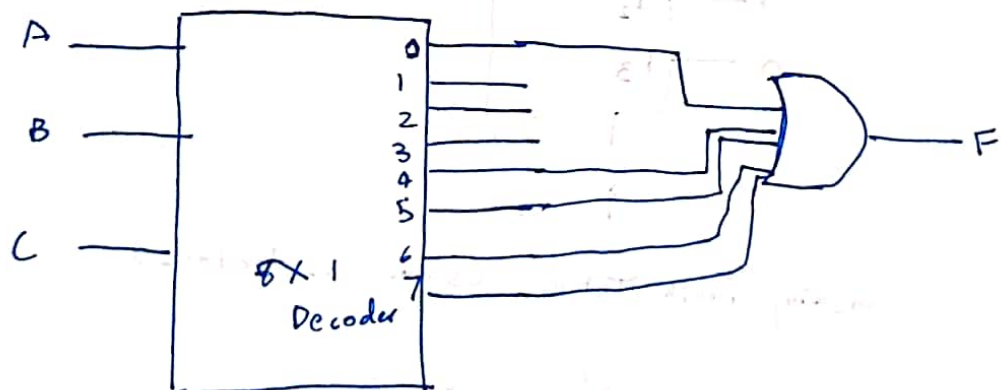
A \ BC	00	01	11	10
0	0	1	1	0
1	1	1	1	1

$$X(A, B, C) = C$$

A \ BC	00	01	11	10
0	0	1	1	1
1	1	1	1	1

$$\begin{aligned} \therefore X(A, B, C) &= A \oplus B \oplus C \\ &= A \text{ XNOR } B \text{ XNOR } C \end{aligned}$$

$$\begin{aligned} b) F = A + \bar{B}\bar{C} &= A(B + \bar{B})(C + \bar{C}) + \bar{B}\bar{C}(A + \bar{A}) \\ &= ABC + AB\bar{C} + A\bar{B}C + A\bar{B}\bar{C} + \bar{A}\bar{B}\bar{C} \\ &= \sum (7, 6, 5, 4, 0) \end{aligned}$$



2) According to Question, Truth Table will be

no.	A <sub>3</sub>	A <sub>2</sub>	A <sub>1</sub>	A <sub>0</sub>	B <sub>3</sub>	B <sub>2</sub>	B <sub>1</sub>	B <sub>0</sub>
0	0	0	0	0	0	0	0	0
1	0	0	0	1	1	1	1	1
2	0	0	1	0	1	1	1	0
3	0	0	1	1	1	1	0	1
4	0	1	0	0	1	1	0	0
5	0	1	0	1	1	0	1	1
6	0	1	1	0	1	0	1	0
7	0	1	1	1	1	0	0	1
8	1	0	0	0	1	0	0	0
9	1	0	0	1	<del>1</del> 0	<del>1</del> 1	<del>1</del> 1	<del>1</del> 1
10	1	0	1	0	<del>1</del> 0	<del>1</del> 1	<del>1</del> 1	<del>0</del> 0
11	1	0	1	1	<del>1</del> 0	<del>1</del> 1	<del>0</del> 0	<del>1</del> 1
12	1	1	0	0	<del>1</del> 0	<del>1</del> 1	<del>0</del> 0	<del>1</del> 0
13	1	1	0	1	<del>1</del> 0	<del>0</del> 0	<del>1</del> 1	<del>1</del> 1
14	1	1	1	0	<del>1</del> 0	<del>0</del> 0	<del>1</del> 1	<del>0</del> 0
15	1	1	1	1	<del>1</del> 0	<del>0</del> 0	<del>0</del> 0	<del>1</del> 1

→ now as +9, +10, ..., +15 takes give 5 digit

$2^4$  complement representation, we can't display it here,

so we treat them as don't care

B<sub>3</sub>

		A <sub>1</sub> A <sub>0</sub>			
A <sub>3</sub> A <sub>2</sub>		00	01	11	10
	00	0	1	1	1
	01	1	1	1	1
	11				
	10	1	0	0	0

$$B_3 = A_3' A_2 + A_3' A_0 + A_3' A_1 + A_3 A_2' A_1' A_0'$$

B<sub>2</sub>

		A <sub>1</sub> A <sub>0</sub>			
A <sub>3</sub> A <sub>2</sub>		00	01	11	10
	00	0	1	1	1
	01	1			
	11		1	1	1
	10	1			

$$B_2 = A_3' A_2' A_1 + A_3' A_2' A_1' A_0 + A_3' A_2 A_1' A_0' + A_3 A_2 A_1' A_0 + A_3 A_2 A_1 + A_3 A_2' A_1' A_0'$$

B<sub>1</sub>

		A <sub>1</sub> A <sub>0</sub>			
A <sub>3</sub> A <sub>2</sub>		00	01	11	10
	00	0	1	0	1
	01		1		1
	11		1		1
	10		1		1

$$B_1 = A_1' A_0 + A_1 A_0'$$

B<sub>0</sub>

		A <sub>1</sub> A <sub>0</sub>			
A <sub>3</sub> A <sub>2</sub>		00	01	11	10
	00		1	1	
	01		1	1	
	11		1	1	
	10		1	1	

$$B_0 = A_0$$

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Pg 5