

DLD

ASSIGNMENT 04

5.4

a)

P	N	$Q(t+1)$
0	0	0
0	1	$Q(t)$
1	0	$Q'(t)$
1	1	1

b) $Q(t+1) = PQ' + NQ$

P	N	$Q(t)$	$Q(t+1)$
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1

P \ NQ	00	01	11	10
0	0	0	1	0
1	1	0	1	1

c)

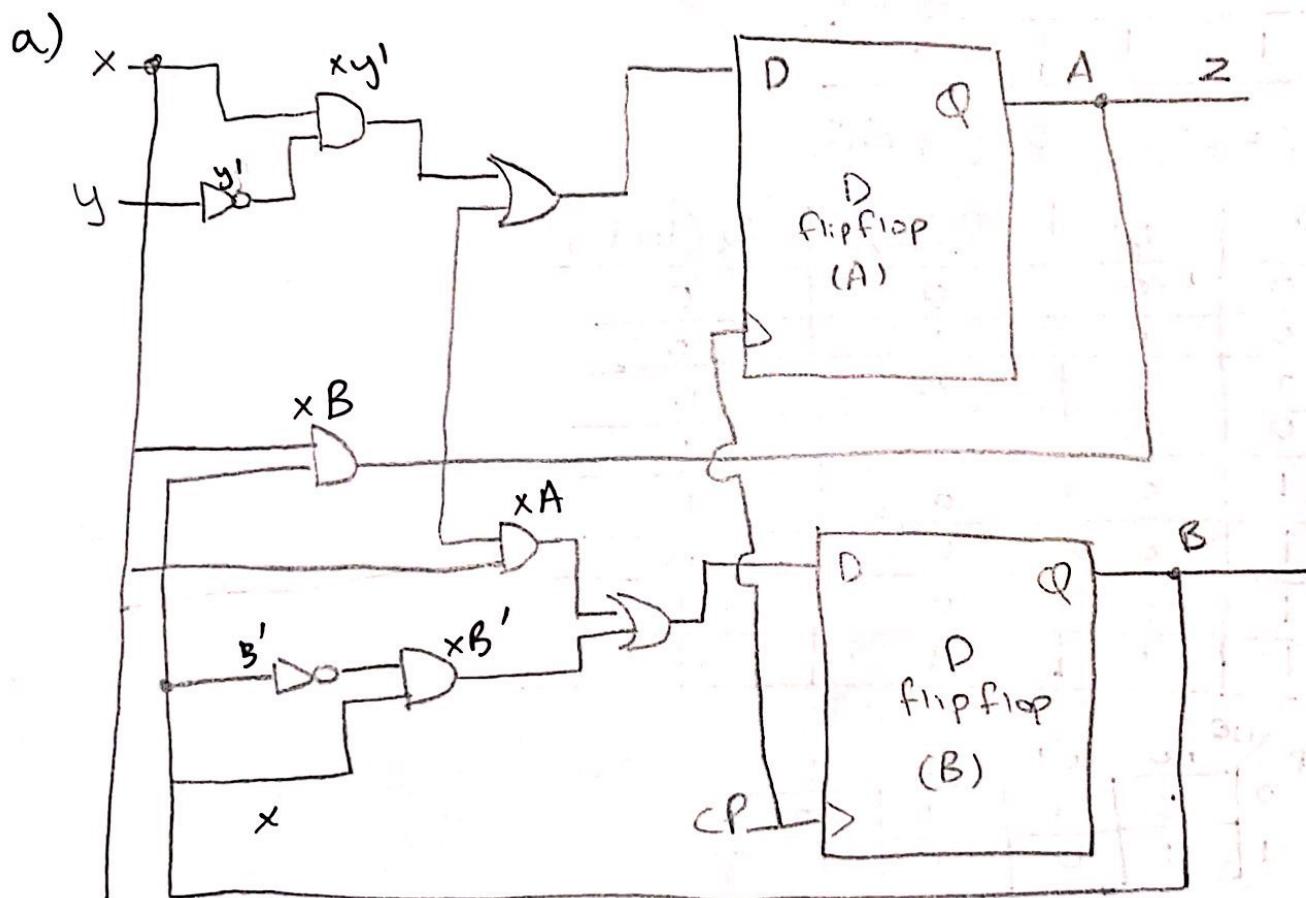
$Q(t)$	$Q(t+1)$	P	N
0	0	0	x
0	1	1	x
1	0	x	0
1	1	x	1

d) connecting P and Q together



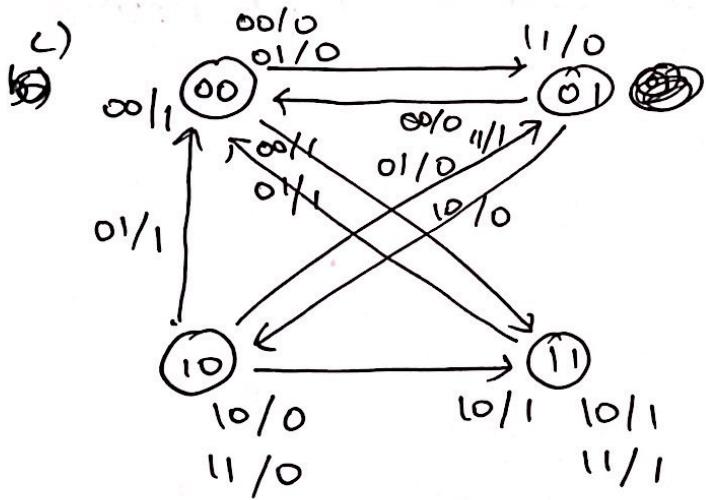
5.6

$$A(t+1) = xy' + xB \\ B(t+1) = xA + xB' \\ z = A$$



b)

$A(t)$	$B(t)$	X	y	$A(t+1)$	$B(t+1)$	z
0	0	0	0	0	0	0
0	0	0	1	0	0	0
0	0	1	0	1	1	0
0	0	1	1	0	1	0
0	1	0	0	0	0	0
0	1	0	1	0	0	0
0	1	1	0	1	0	0
0	1	1	1	1	0	-0
1	0	0	0	0	0	1
1	0	0	1	0	0	1
1	0	1	0	1	1	1
1	0	1	1	0	1	1
1	1	0	0	0	0	1
1	1	0	1	0	0	1
1	1	1	0	1	1	1
1	1	1	1	1	1	1

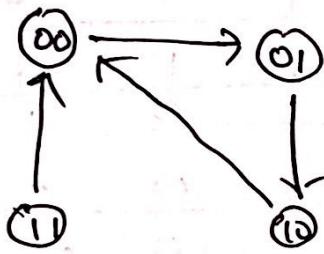


5.8.

$$T_A = A + B \quad , \quad T_B = A' + B$$

$\rightarrow 00 \rightarrow 01 \rightarrow 10 \rightarrow$

$A(t)$	$B(t)$	$A(t+1)$	$B(t+1)$	$T_A T_B$
0	0	0	1	0 1
0	1	1	0	1 1
1	0	0	0	1 0
1	1	0	0	1 0 1

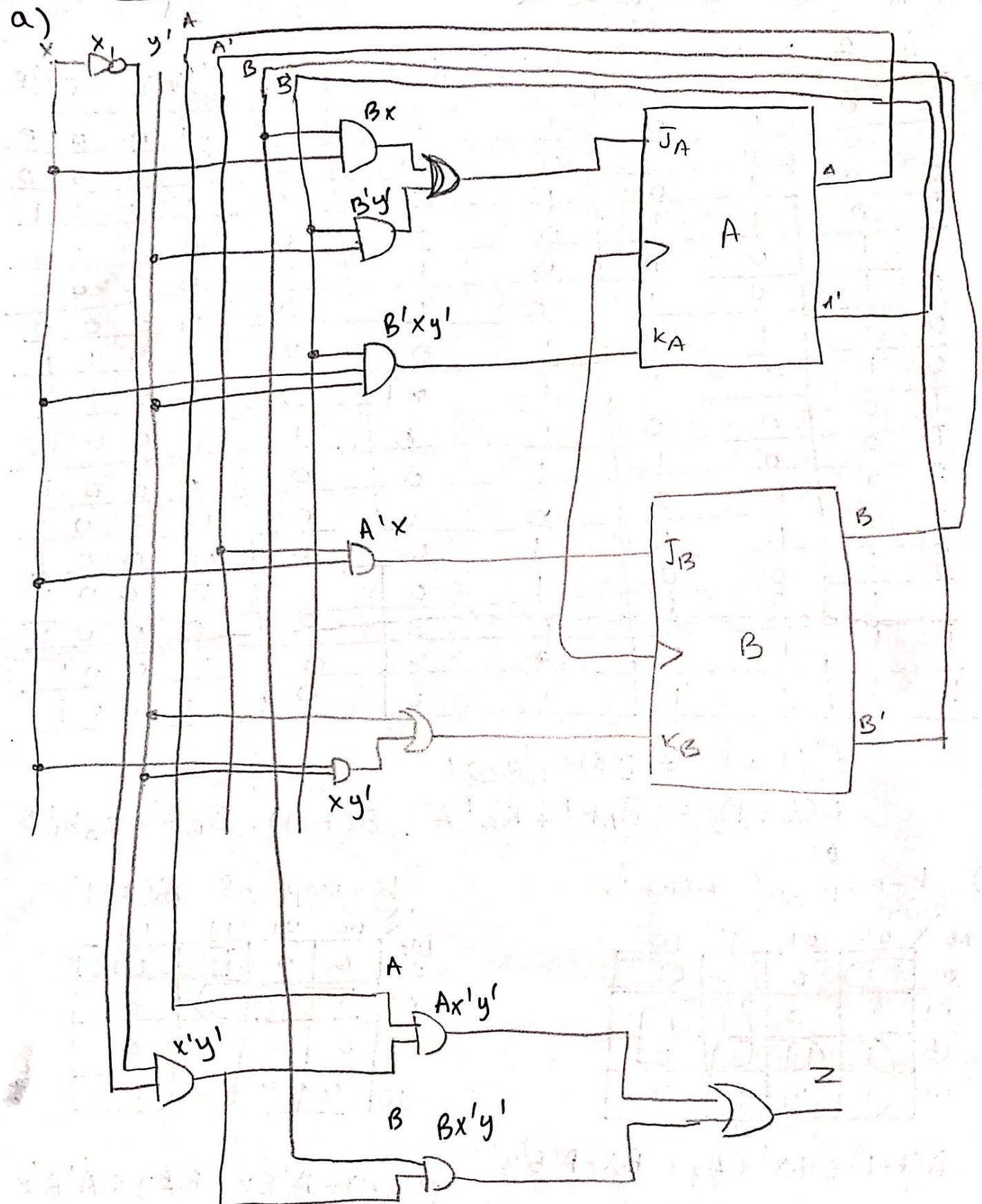


$$T_A = A + B \quad , \quad T_B = A' + B$$

$\rightarrow 00 \rightarrow 01 \rightarrow 10 \rightarrow$ repeated sequence

This circuit is a counter with repeated sequence of 00, 01, 10

S.10



b) ~~A B~~ ~~X Y~~

A	B	X	Y	A(t+1)	B(t+1)	Z	$J_A K_A$	$J_B K_B$
0	0	0	0	1	0	0	1 0 0 0	
0	0	0	1	0	0	0	0 0 0 0	
0	0	1	0	1	1	0	1 1 1 1	
0	0	1	1	0	1	0	0 0 1 0	
0	1	0	0	0	1	1	0 0 0 0	
0	1	0	1	0	1	0	0 0 0 0	
0	1	1	0	1	0	0	1 0 1 1	
0	1	1	1	1	0	0	1 0 1 0	
1	0	0	0	1	0	1	1 0 0 1	
1	0	0	1	1	0	0	0 0 0 1	
1	0	1	0	0	0	0	1 1 0 1	
1	0	1	1	1	0	0	0 0 0 0	
1	1	0	0	1	0	1	0 0 0 1	
1	1	0	1	0	0	0	0 0 0 1	
1	1	1	0	1	0	0	1 0 0 1	
1	1	1	1	0	0	1	1 0 0 1	
1	1	1	0	1	0	0	1 0 0 1	
1	1	1	1	1	0	0	1 0 0 1	

$$Q(t+1) = JQ' + BQ'$$

$$A(t+1) = \overline{J_A}B' + K_A'A, B(t+1) = \overline{J_B}B' + \overline{B}K_B'B$$

♦

c) K-map of $A(t+1)$

AB		XY				
		00	01	11	10	
00	1	0	0	1		
	0	0	1	1		
10	1	0	1	1		
	1	1	1	0		

$$A(t+1) = Ax' + Ay + Bx + A'B'y'$$

K-map of $B(t+1)$

AB		XY				
		00	01	11	10	
00	0	0	1	1		
	1	1	1	1		
10	0	0	0	0		
	0	0	0	0		

$$B(t+1) = A'Bx + A'By + A'B'y$$

S. 19

a)

A	B	C	X	A(t+1)	B(t+1)	C(t+1)	Y
0	0	0	0	0	0	1	0
0	0	0	1	1	0	0	1
0	0	1	0	0	0	1	0
0	0	1	1	1	0	0	1
0	1	0	0	0	1	0	0
0	1	0	1	0	0	0	1
0	1	1	0	0	0	1	0
0	1	1	1	0	1	0	1
1	0	0	0	0	1	0	0
1	0	0	1	0	0	1	0

$$J(A, B, C, X) = \sum(10, 11, 12, 13, 14, 15)$$

K-map of $A(t+1)$

AB	00	01	11	10
00	0	1	1	0
01	0	0	0	0
11	x	x	x	x
10	0	0	x	x

K-map of $B(t+1)$

AB	00	01	11	10
00	1	0	0	0
01	1	0	1	0
11	x	x	x	x
10	1	1	x	x

$$D_A = A'B'C'$$

$$D_B = A + C'x' + BCx$$

K-map of $C(t+1)$

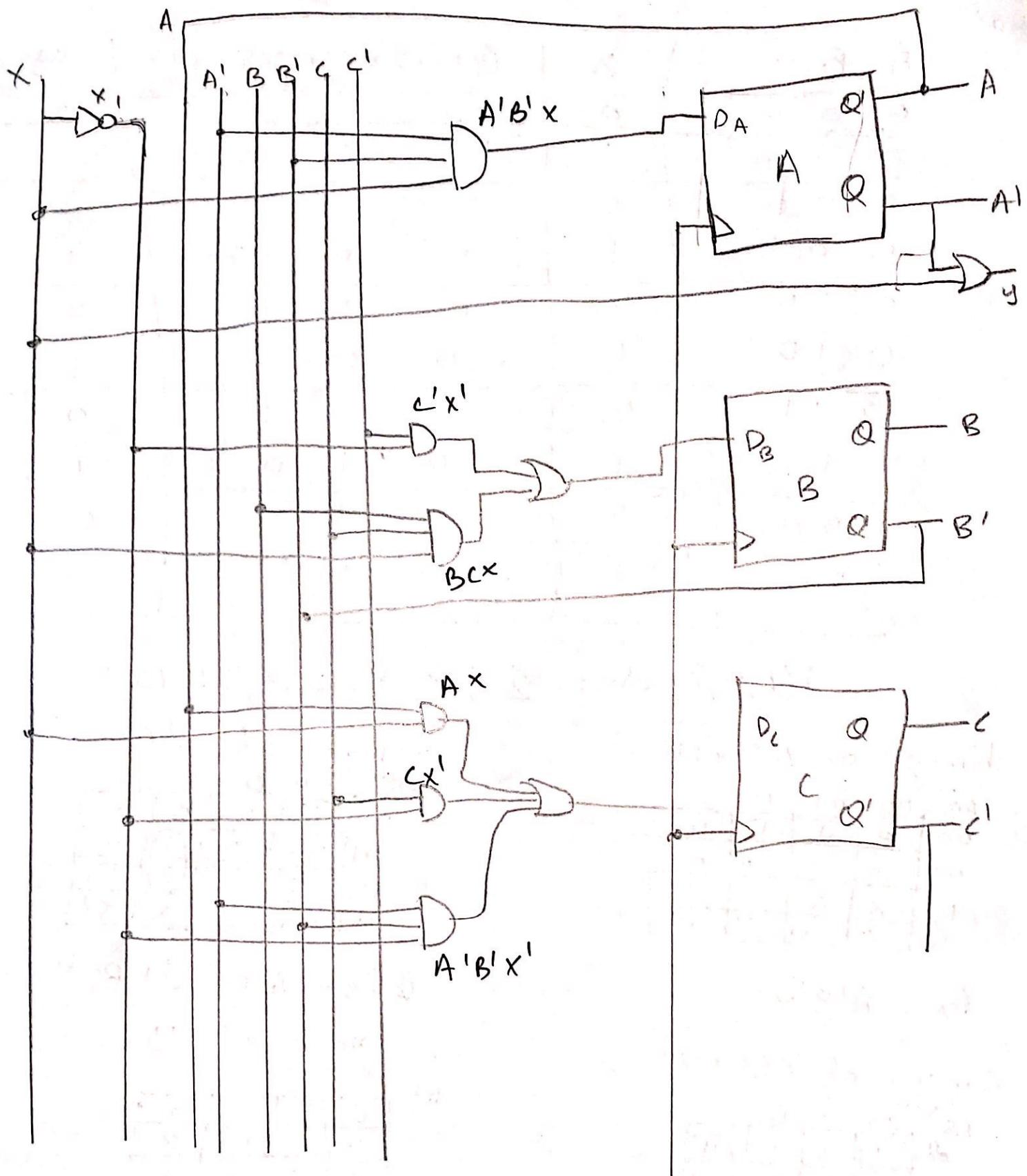
AB	00	01	11	10
00	1	0	0	1
01	0	0	0	1
11	x	x	x	x
10	0	1	x	x

$$D_C = Ax + Cx' + A'B'C'$$

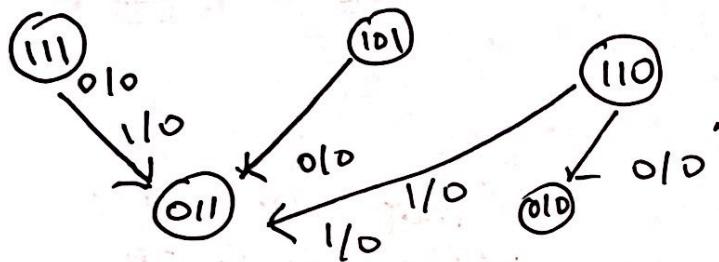
K-map of Y

AB	00	01	11	0
00	1	1	0	0
01	1	1	0	0
11	x	x	x	x
10	0	0	x	x

$$y = A'x$$



A	B	C	X	A(t+1) B(t+1) C(t+1)	Y
1	0	1	0	0 1 1	0
1	0	1	1	0 1 1	0
1	1	0	0	0 1 0	0
1	1	0	1	0 1 1	0
1	1	1	0	0 1 1	0
1	1	1	1	0 1 1	0



b)

A	B	C	X	A(t+1) B(t+1) C(t+1)	J _A K _A	J _B K _B	J _C K _C
0	0	0	0	0 1 1	0 X	1 X	1 X
0	0	0	1	1 0 0	1 X	0 X	0 X
0	0	1	0	0 0 1	0 X	0 X	X 0
0	0	1	1	1 0 0	1 X	0 X	X 1
0	1	0	0	0 1 0	0 X	X 0	0 X
0	1	0	1	0 0 0	0 X	X 1	0 X
0	1	1	0	0 0 1	0 X	X 1	X 0
0	1	1	1	0 1 0	0 X	X 0	X 1
1	0	0	0	0 1 0	X 1	1 X	0 X
1	0	0	1	0 1 1	X 1	1 X	1 X

K map of J_A

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

$$J_A = B' \cdot \bar{C}$$

K map of K_A

AB\C	X	00	01	11	10
00		X	X	X	X
01		X	X	X	X
11		X	X	X	X
10		1	1	X	X

$$K_A = 1$$

Kmap of J_B

AB	CX	00	01	11	10
00		1	0	0	0
01		X	X	X	X
11		X	X	X	X
10		1	1	X	X

$$\bar{J}_B = A + C'X$$

Kmap of K_B

AB	CX	00	01	11	10
00		X	X	X	X
01		0	1	0	1
11		X	X	X	X
10		X	X	X	X

$$K_B = C'X + CX' \Rightarrow$$

$$K_B = C \oplus X$$

Kmap of J_C

AB	CX	00	01	11	10
00		1	0	X	X
01		0	0	X	X
11		X	X	X	X
10		0	1	X	X

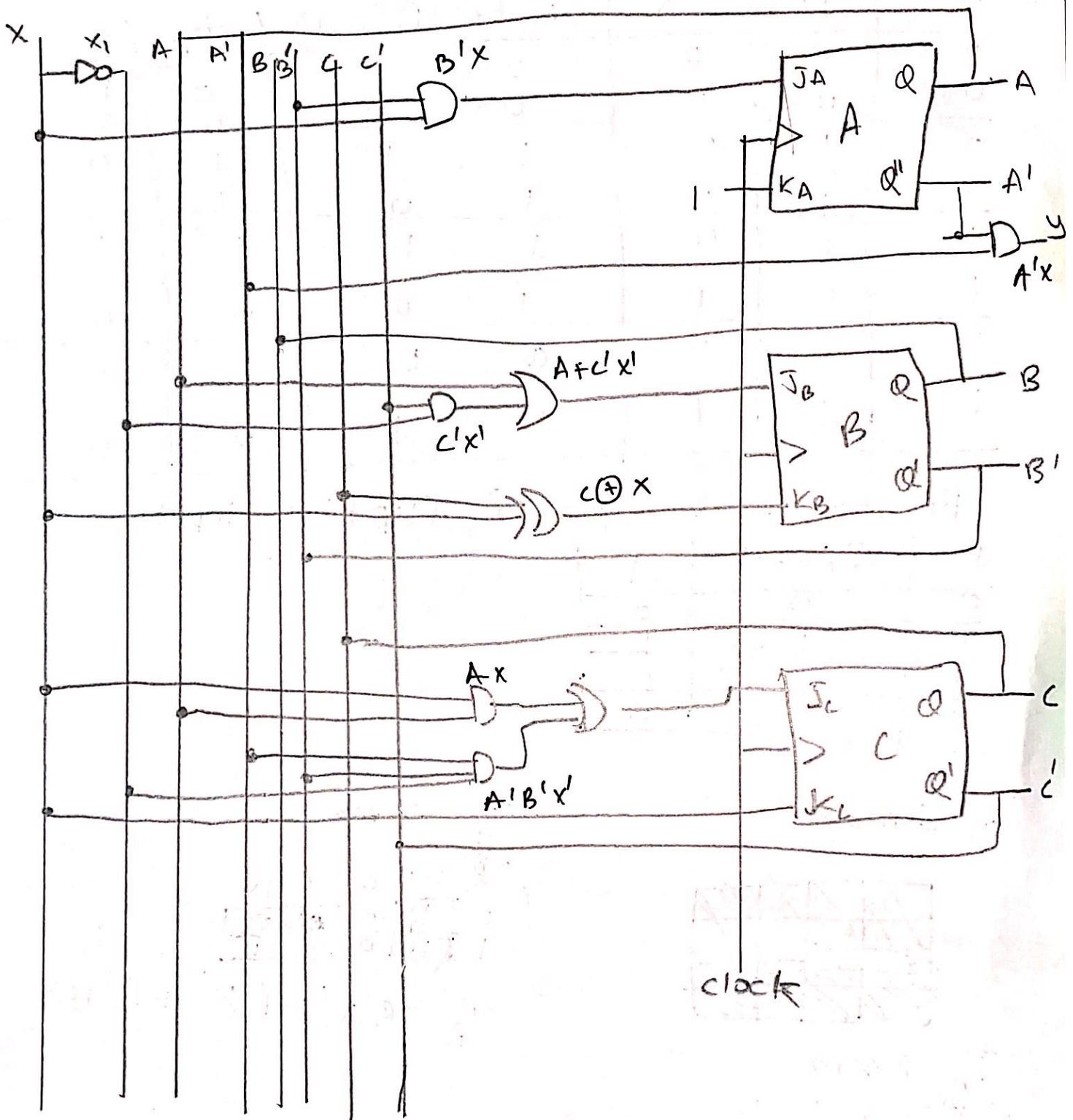
$$\bar{J}_C = Ax + A'B'C$$

Kmap of K_C

AB	CX	00	01	11	10
00		X	X	1	0
01		X	X	1	0
11		X	X	X	X
10		X	1	X	X

$$K_C = X$$

$$y = A'X$$



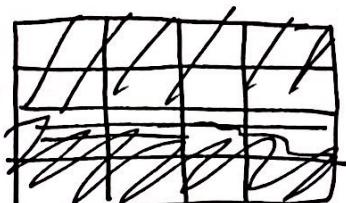
S.20

A	B	X	$A(t+1)B(t+1)$	T_A	T_B
0	0	0	0 1	0 0	1 0
0	0	1	0 0	0 0	0 0
0	1	0	1 1	1 1	0 1
0	1	1	1 0	0 1	1 1
1	0	0	1 1	0 0	0 0
1	0	1	1 0	0 0	0 0
1	1	0	0 0	1 1	1 1
1	1	1	1 1	0 0	0 0

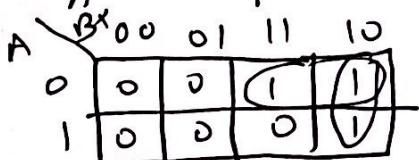
Excitation table of flip flop inputs

Q	$Q(t+1)$	T
0	0	0
0	1	1
1	0	1
1	1	0

T_A Kmap

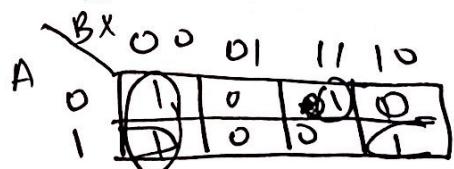


T_A Kmap

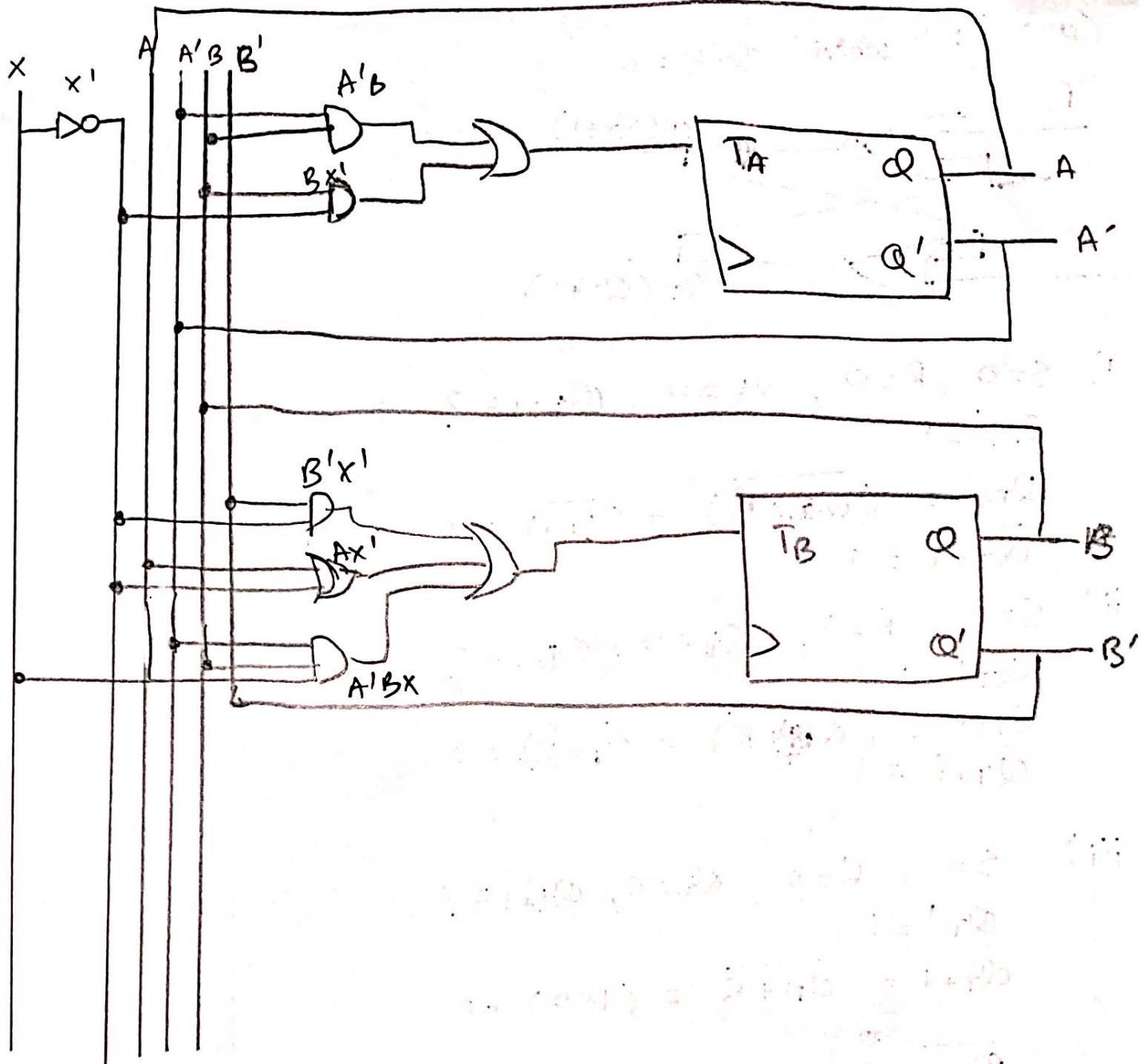


$$T_A = A'B + B'X$$

T_B Kmap

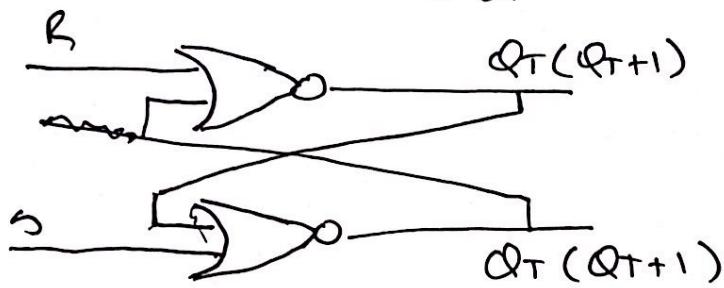


$$T_B = B'X' + AX' + A'BX$$



Part 2 SR LATCH

Case 1: when $Q(t) = 0$



i) $S=0, R=0, Q_t=0, Q_{t+1}=?$
 $Q_t' = 1$

$$\frac{Q_{t+1}}{\overline{Q_{t+1}}} = \left(\overline{Q_t' + R} \right) = \left(\overline{1+0} \right) = 0$$

$$\overline{Q_{t+1}} = 1$$

ii) $S=0, R=1, Q_t=0, Q_{t+1}=?$
 $Q_t' = 1$

$$\frac{Q_{t+1}}{\overline{Q_{t+1}}} = \left(\overline{Q_t' + R} \right) = \left(\overline{1+1} \right) = 0$$

iii) $S=1, R=0, Q_t=0, Q_{t+1}=?$
 $Q_t' = 1$

$$Q_{t+1} = \overline{Q_t' + R} = (1+0) = 0$$

$$\overline{Q_{t+1}} = 1$$

iv) $S=1, R=1, Q_t=0, Q_{t+1}=?$
 $Q_t' = 1$

$$Q_{t+1} = \overline{(Q_t' + R)} = (1+1) = 0 \quad Q_{t+1} = (\overline{Q_t} + S) = \overline{0+1} = 0$$

undefined

Case 2: when $Q_t = 1$

v) $S=0, R=0, Q_t=1, Q_{t+1}=?$
 $Q_{t+1}'=0$

$$Q_{t+1} = (\overline{Q_t + R}) = (\overline{0+0})$$

$$Q_{t+1} = 1$$

$$\overline{Q_{t+1}} = 0$$

vi) $S=0, R=1, Q_t=1, Q_{t+1}=?$

$$Q_{t+1}'=0$$

$$Q_{t+1} = (\overline{Q_t + R})$$

$$= (0+1) = 0$$

$$\overline{Q_{t+1}} = 1$$

vii) $S=1, R=0, Q_t=1, Q_{t+1}=?$

$$Q_{t+1}'=0$$

$$Q_{t+1} = (\overline{Q_t + R})$$

$$= (0+0)$$

$$\overline{Q_{t+1}} = 1$$

$$Q_{t+1} = 0$$

viii) $S=1, R=1, Q_t=1, Q_{t+1}=?$

$$Q_{t+1}'=0$$

$$Q_{t+1} = (\overline{Q_t + R})$$

$$= (0+1)$$

$$= 0$$

$$Q_{t+1} = (Q_t + S)$$

$$= (1+1)$$

$$= 0$$

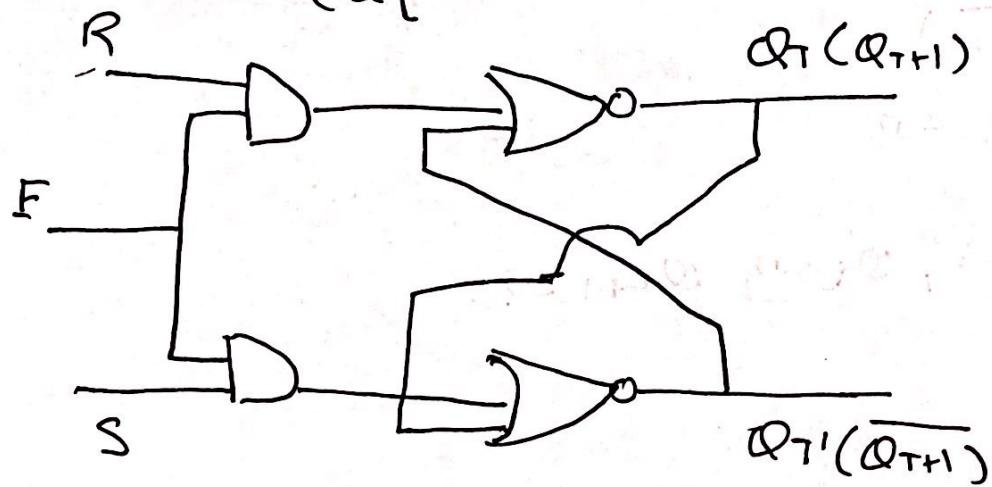
undefined

S	R	Q'	Q
0	0	undefined	undefined
0	1	1	0
1	0	0	1
1	1	Q'	$Q \rightarrow \text{hold}$

Q_T	S	R	Q_{T+1}	Q_{T+1}
0	0	0	0	1
0	0	1	0	1
0	1	0	0	1
0	1	1	0	1
1	0	0	0	0
1	0	1	1	0
1	1	0	0	1
1	1	1	1	0

Gated - SR Latch

Case 1: ~~Q_t~~



Case 1: $Q_t = 0$

i) $E=0, S=x, R=x, Q_t=0, Q_{t+1}=?$
 $A = E \cdot R$

$$A = 0 \cdot x$$

$$A = 0$$

$$Q_{t+1} = (\overline{A + Q_t'}) = (\overline{0 + 1}) = 0$$

$$\overline{Q_{t+1}} = 1$$

ii) $E=1, S=0, R=0, Q_t=0, Q_{t+1}=?$
 $A = E \cdot R = 1 \cdot 0 = 0$

$$Q_t' = 1$$

$$Q_{t+1} = (\overline{A + Q_t'})$$

$$= (\overline{0 + 1}) = 0$$

$$\overline{Q_{t+1}} = 1$$

iii) $E=1, S=0, R=1, Q_t=0, Q_{t+1}=?$
 $A = E \cdot R = 1 \cdot 1 = 1$

$$Q_t' = 1$$

$$Q_{t+1} = (\overline{A + Q_t'})$$

$$= (1 + 1)$$

$$\overline{Q_{t+1}} = 0$$

$$Q_{t+1} = 1$$

iv) $E=1, S=1, R=0, Q_t=0, Q_{t+1}=?$

$$A = E \cdot R^* = \frac{1 \cdot 0}{1+0} = 0$$

$$Q_t' = 1$$

$$Q_{t+1} = (\overline{A + Q_t'})$$

$$\overline{Q_{t+1}} = \overline{(0+1)} = 0$$

v) $E=1, S=1, R=1, Q_t=0, Q_{t+1}=?$

$$A = E \cdot R = 1 \cdot 1 = 1$$

$$Q_t' = 1$$

$$Q_{t+1} = (\overline{A + Q_t'})$$

$$\overline{Q_{t+1}} = \overline{(1+1)} = 0$$

Case 2 : $Q_t = 1$

i) $E=0, S=x, R=x, Q_t=1, Q_{t+1}=?$

$$A = E \cdot R = 0 \cdot x = 0$$

$$Q_t' = 0$$

$$Q_{t+1} = (\overline{A + Q_t'})$$

$$\overline{Q_{t+1}} = \overline{(0+0)} = 1$$

ii) $E=0, S=0, R=0, Q_t=1, Q_{t+1}=?$

$$A = E \cdot R = 0 \cdot 0 = 0$$

$$Q_t' = 0$$

$$Q_{t+1} = (\overline{A + Q_t'})$$

$$\overline{Q_{t+1}} = \overline{(0+0)} = 1$$

iii) $E=0, S=0, R=1, Q_t=1, Q_{t+1}=?$

$$A = E \cdot R = 0 \cdot 1 = 0$$

$$Q_t' = 0$$

$$Q_{t+1} = (\overline{A + Q_t'})$$

$$= (0 + 0) = 1$$

$$\overline{Q_{t+1}} = 0$$

iv) $E=0, S=1, R=0, Q_t=1, Q_{t+1}=?$

$$A = E \cdot R = 0 \cdot 0 = 0$$

$$Q_t' = 0$$

$$Q_{t+1} = (\overline{A + Q_t'})$$

$$= (0 + 0) = 1$$

$$\overline{Q_{t+1}} = 0$$

v) $E=0, S=1, R=1, Q_t=1, Q_{t+1}=?$

$$A = E \cdot R = 0 \cdot 1 = 0$$

$$Q_t' = 0$$

$$Q_{t+1} = (\overline{A + Q_t'})$$

$$= (0 + 0) = 1$$

$$\overline{Q_{t+1}} = 0$$

Q_t	R	S	E	Q_{t+1}	$\overline{Q_{t+1}}$
0	x	x	0	0	1
0	0	0	1	0	1
0	1	0	1	0	1
0	0	1	1	0	1
0	1	1	1	0	1
1	x	x	0	1	0
1	0	0	0	1	0
1	1	0	0	1	0
1	0	1	0	1	0
1	1	1	0	1	0

t	S	R	Q'	Q
0	x	x	hold	hold
1	0	0	hold	hold
1	0	1	0	1
1	1	0	1	0
1	1	1	undefined hold	undefined hold