Digital & Logic Design

Assignment #05

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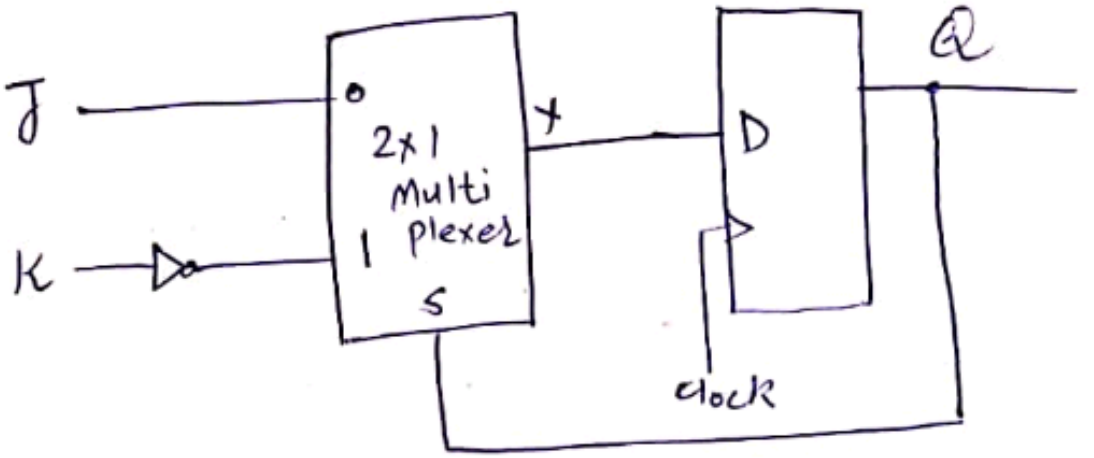
(1)

— (5.2) —

$D = JQ' + K'Q$

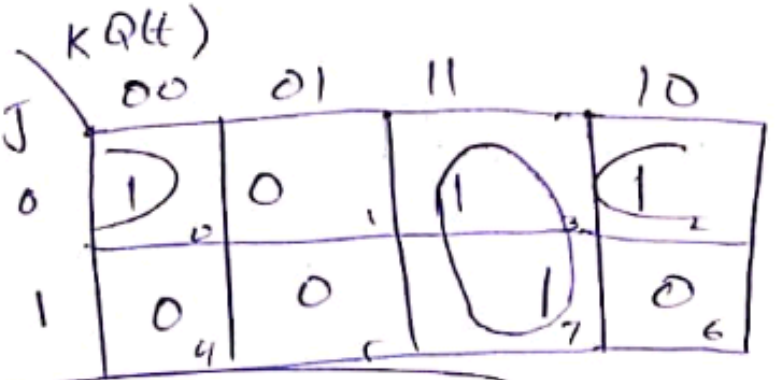


— (5.3) —

$Q(t+1) = TQ' + T'Q$

J	K	Q(t)	Q(t+1)	Q'(t+1)
0	0	0	0	1
0	0	1	1	0
0	0	0	0	1
0	1	1	0	1
0	1	0	1	0
1	0	1	1	0
1	0	0	1	0
1	1	1	0	1
1	1	0	1	0

K-map



$Q'(t+1) = KQ + J'Q'$

—(5.4)—

a) Characteristic table

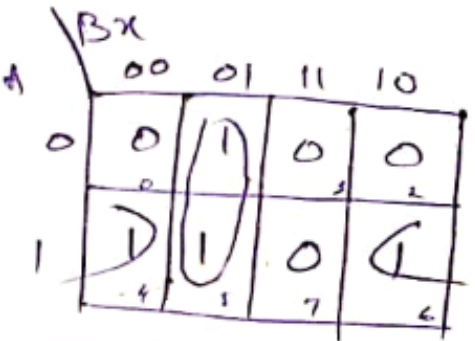
A	B	Q(t+1)
0	0	No change
0	1	0
1	0	1
1	1	Complement

b) Excitation

A	B	J	K
		Q(t+1)	
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

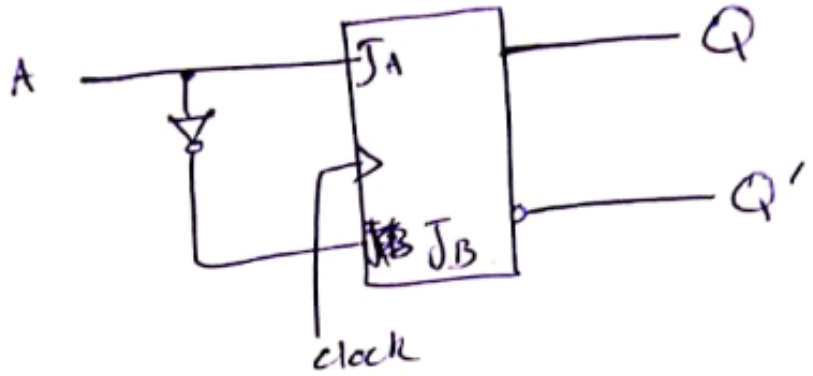
c) Characteristic equation:

A	B	x	Q(t+1)
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0



$Q(t+1) = Ax' + B'x$

a)



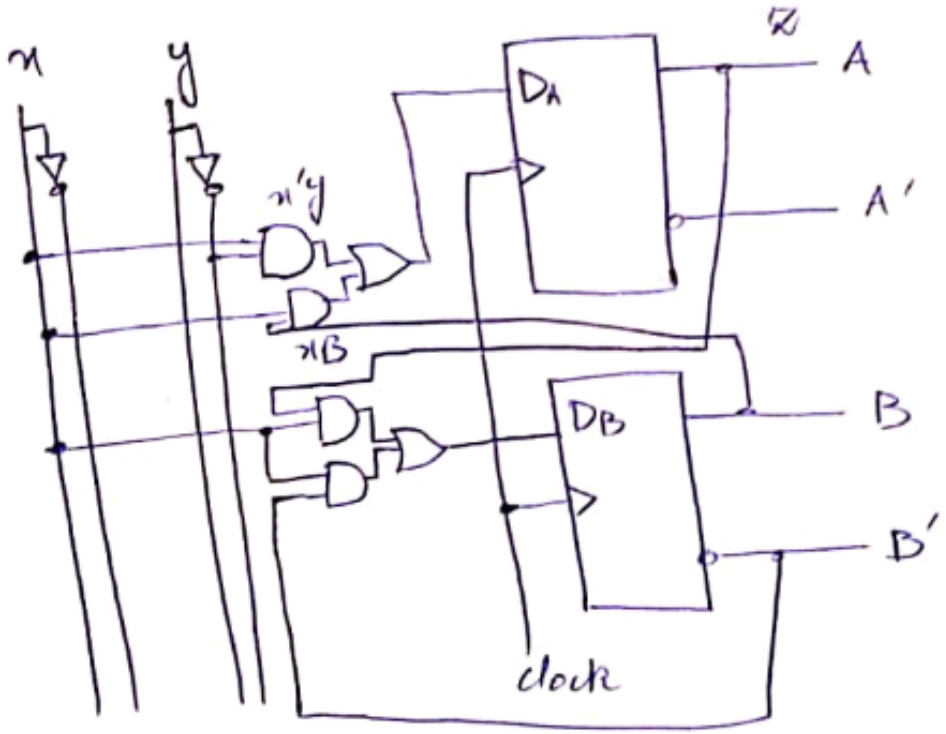
– (5.6) –

$$A(t+1) = xy' + xB$$

$$B(t+1) = xA + xB'$$

$$z = A$$

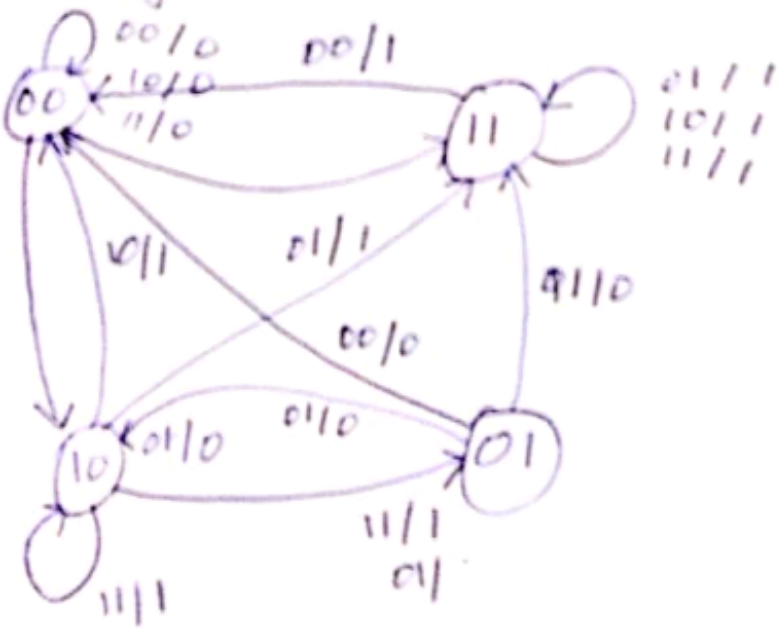
a) Logic Diagram



b) State table:

A	B	x	y	A(t+1)	B(t+1)	Z
0	0	0	0	0	0	0
0	0	0	1	1	0	0
0	0	1	0	0	0	0
0	0	1	1	0	0	0
0	1	0	0	0	0	0
0	1	0	1	1	0	0
0	1	1	0	1	0	0
0	1	1	1	1	1	0
1	0	0	0	0	1	1
1	0	0	1	1	1	1
1	0	1	0	0	0	1
1	0	1	1	0	0	1
1	1	0	0	0	1	1
1	1	0	1	1	1	1
1	1	1	0	1	1	1
1	1	1	1	1	1	1

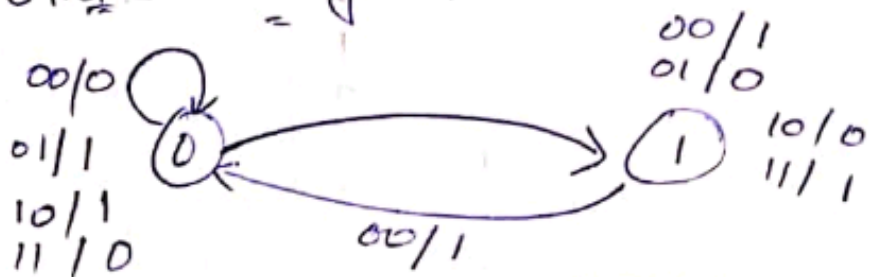
c) State Diagram:



(5.7)

Q	x	y	Carry Q(t+1)	output Sum
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

State Diagram:

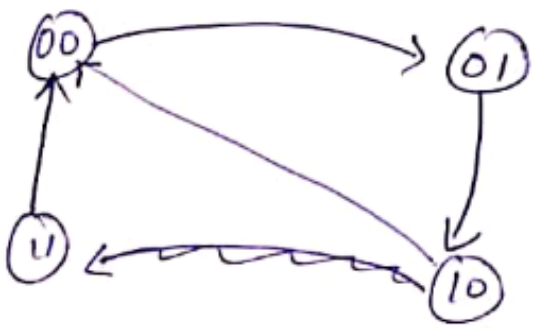


(5.8)

$T_A = A + B$ ∴ no input

$T_B = A'B$

Given A	Given B	Find A(t+1)	Find B(t+1)	Given T_A	Given 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	1

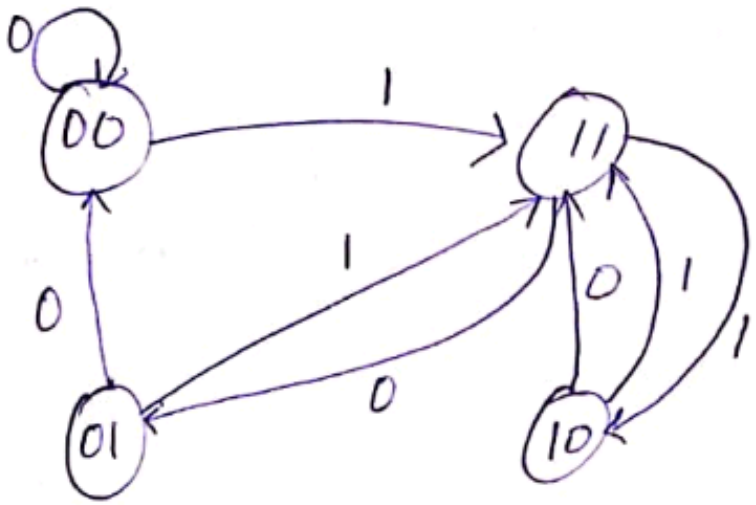


-(5.9)-

$J_A = x$, $K_A = B$

$J_B = x$, $K_B = A'$

A	B	x	A(t+1)	B(t+1)	J_A	K_A	J_B	K_B
0	0	0	0	0	0	0	0	1
0	0	1	1	1	1	0	1	1
0	1	0	0	0	0	1	0	1
0	1	1	1	1	1	1	1	1
0	0	0	0	1	0	0	1	0
1	0	1	1	1	1	0	1	0
1	1	0	0	1	0	1	0	0
1	1	1	0	0	1	1	1	0



(1)

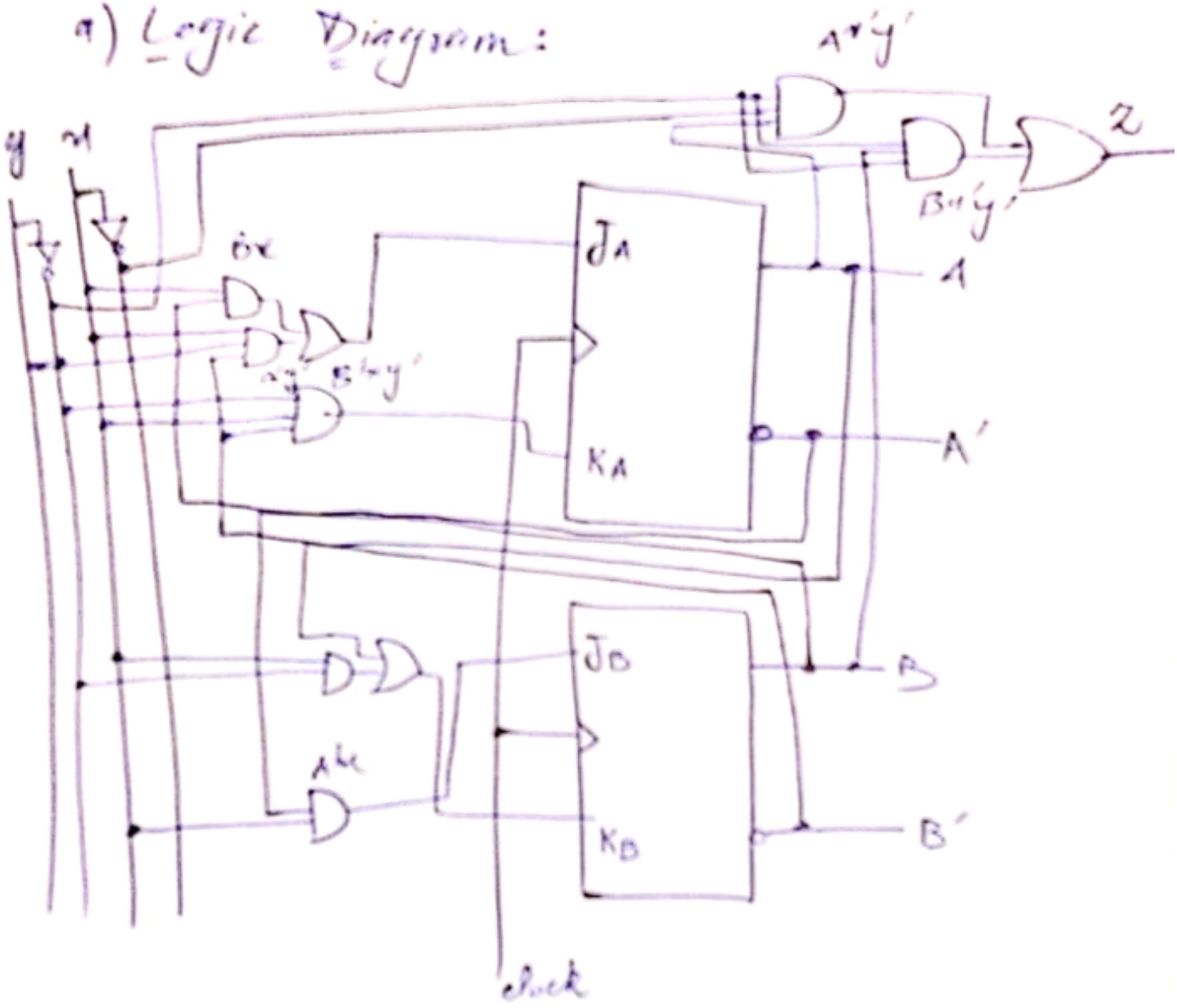
– (5.10) –

$$J_A = Bx + B'y' \;,\; K_A = B'xy'$$

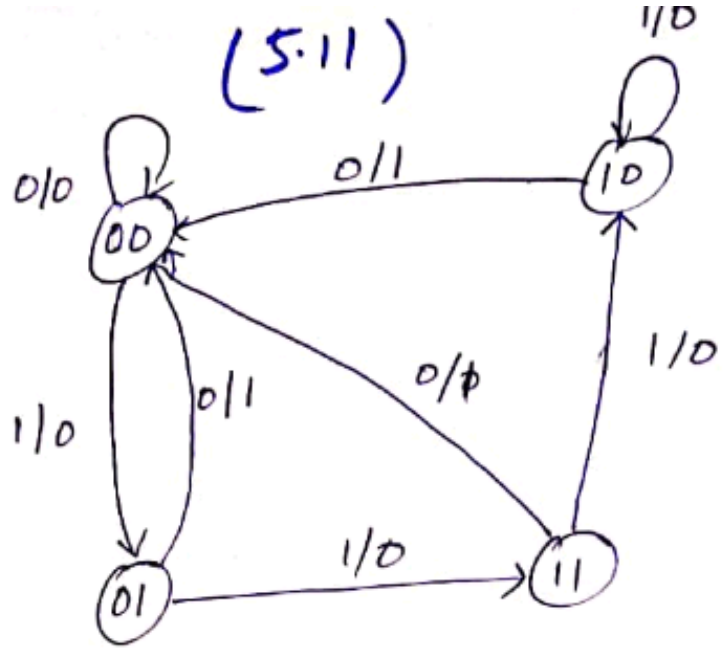
$$J_B = A'x \;,\; K_B = Axy'$$

$$z = Ax'y' + Bx'y'$$

a) Logic Diagram:



(b) (5.11)



input = 0101101110111110

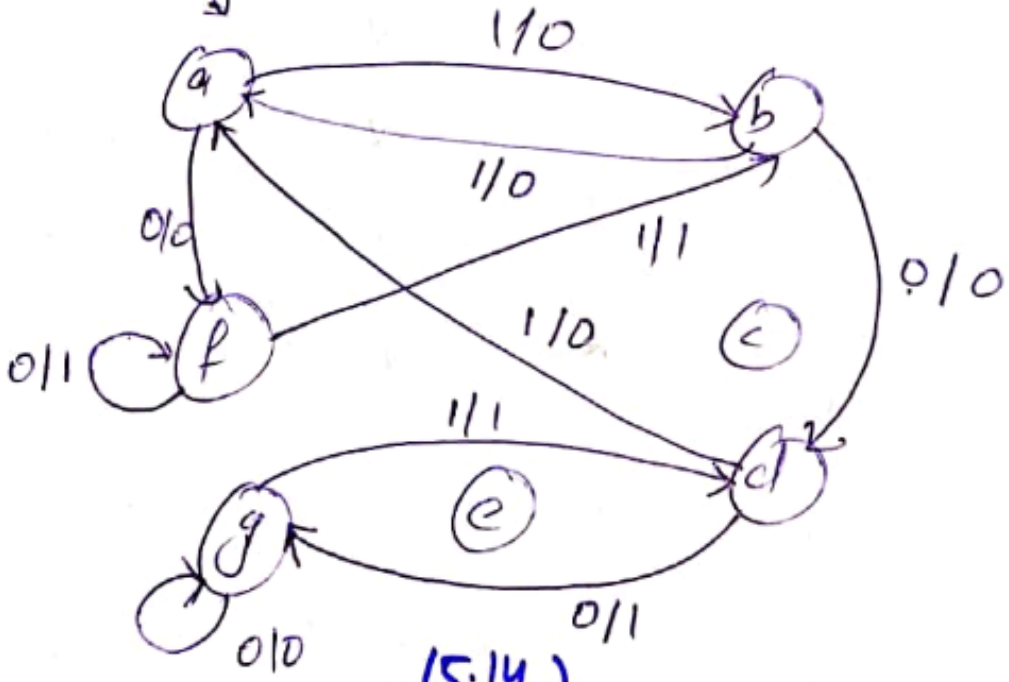
A	B	x	output	Next state	
0	0	0	0	0	0
0	0	1	0	0	1
0	1	0	1	0	0
0	1	1	0	0	1
1	0	0	0	1	1
1	0	1	1	0	0
1	1	0	0	0	1
1	1	1	0	1	1
0	0	0	1	1	0
0	0	1	0	1	0
0	1	0	0	0	0
0	1	1	0	0	1
1	0	0	0	1	1
1	0	1	1	0	0
1	1	0	0	0	1
1	1	1	0	1	1

(a)

– (5.12) –

Present state	Next State $x=0$, $x=1$		output $x=0$	$x=1$
a	f	b	0	0
b	d	a	0	0
d	g	a	1	0
f	f	b	1	1
g	g	d	0	1

State Diagram :



– (5.14) –

present state	$x=0$, $x=1$		$x=0$	$x=1$
00001	000	001	0	0
00010	011	010	0	0
00100	000	010	0	0
01000	110	010	0	1
10000	000	010	0	1

(10) — (5.16) —

* When $x = 0$

No change

* When $x = 1$

$00 \rightarrow 01$

$01 \rightarrow 11$

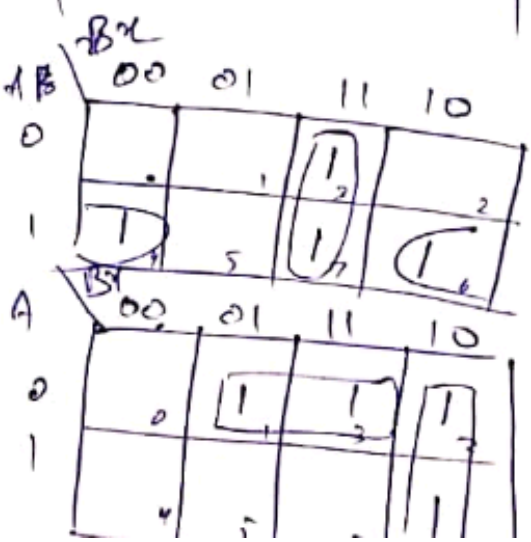
$11 \rightarrow 10$

$10 \rightarrow 00$

Next state & output is same in D flip flop

A	B	x	Q(t+1) A	Q(t+1) B	D_A	D_B
0	0	0	0	0	0	0
0	0	1	0	1	0	1
0	1	0	0	1	0	1
0	1	1	1	1	1	1
1	0	0	1	0	1	0
1	0	1	0	0	0	0
1	1	0	1	0	1	1
1	1	1	1	0	1	0

k-maps



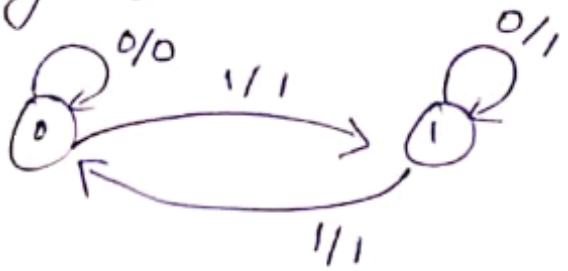
$D_A = Ax' + Bx$

$D_B = A'x + Bx'$

(11) – (5.17) –

Present State A	Input x	Next State Q(t+1)	Output y
0	0	0	0
0	1	1	1
1	0	1	1
1	1	1	0

State Diagram



Kmap of A(t+1)

A \ x	0	1
0	0	1
1	1	1

$D_A = A + x$

Kmap of output (y)

A \ x	0	1
0	0	1
1	1	0

$y = Ax' + A'x$

$y = A \oplus x$

$D_B = A \oplus x$

* When $x = 0$

No change

* When $x = 1$

$00 \rightarrow 01$

$01 \rightarrow 11$

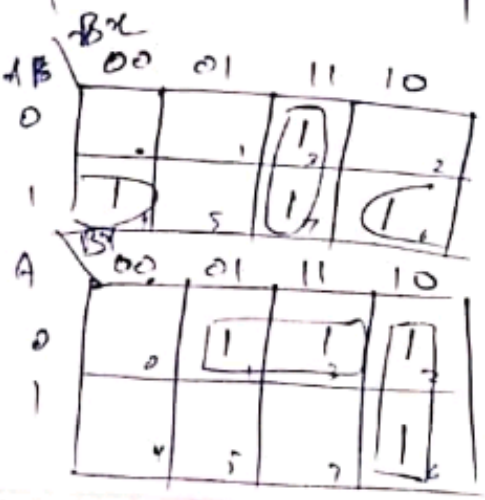
$11 \rightarrow 10$

$10 \rightarrow 00$

Next state & output is same in D flip flop

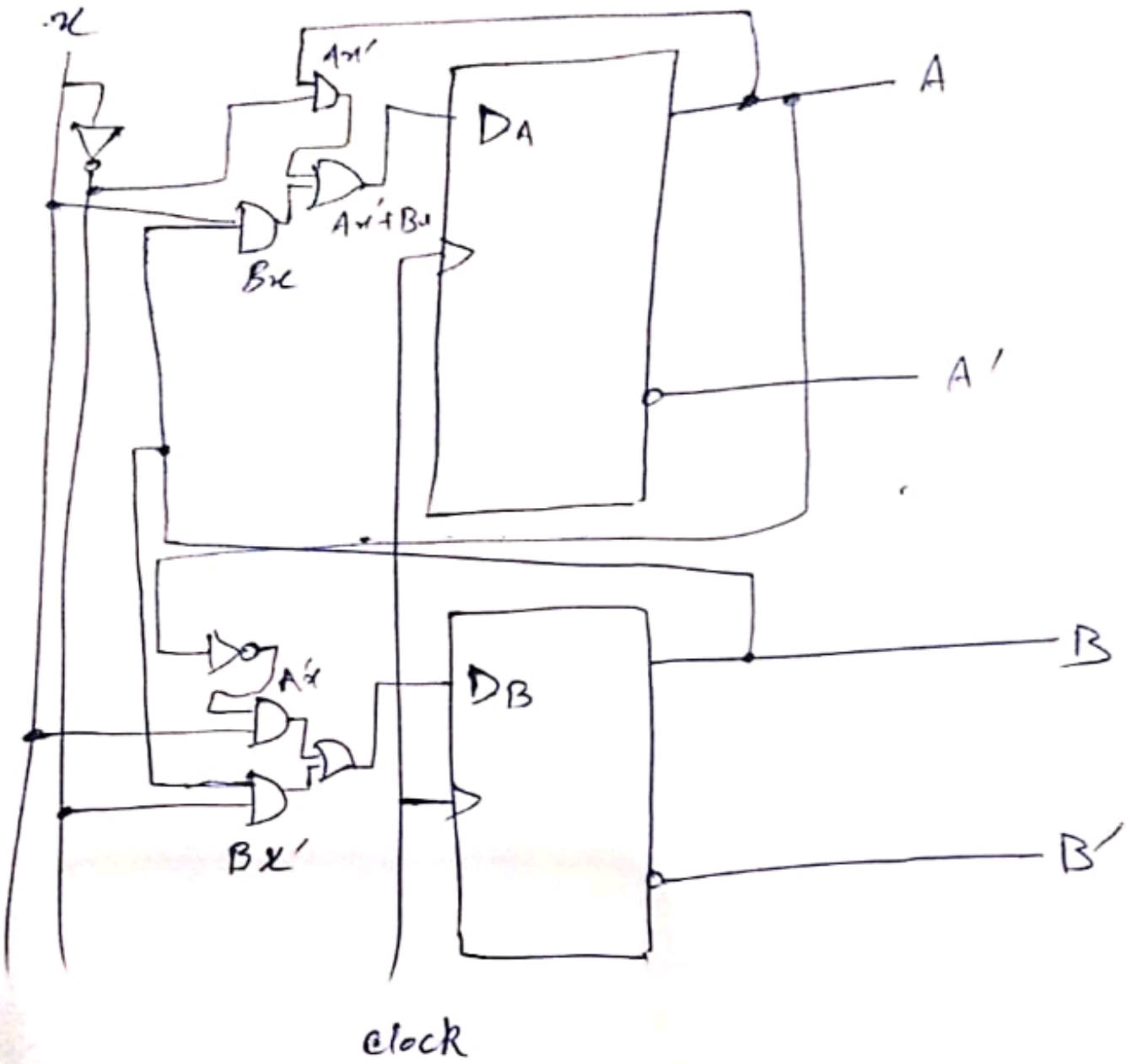
A	B	x	Q(t+1) A	Q(t+1) B	D_A	D_B
0	0	0	0	0	0	0
0	0	1	0	1	0	1
0	1	0	1	1	1	1
0	1	1	1	0	1	0
1	0	0	1	0	1	0
1	0	1	1	1	1	1
1	1	0	1	0	1	0
1	1	1	0	1	1	1

k-maps

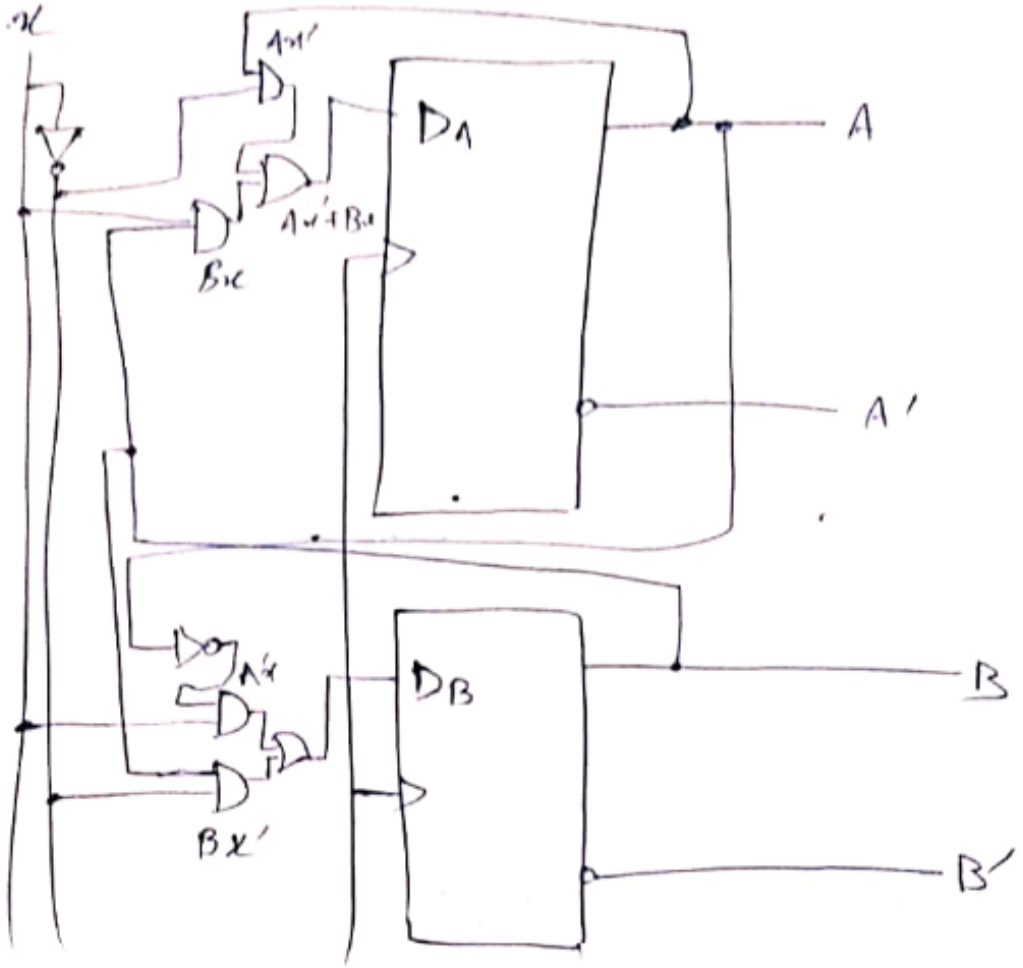


$D_A = Ax' + Bx$

$D_B = A'x + Bx'$


x
Ax'
A
DA
Ax'+Bx
Bx
A'
Ax
DB
B
Bx'
B'
clock

15.16 \ —



b) when $x = 0$

No change

when $x = 1$

$00 \rightarrow 11$

$11 \rightarrow 01$

$01 \rightarrow 10$

$10 \rightarrow 00$

present state		input	next state & outputs	
A	B	x	D_A	D_B
0	0	0	0	0
0	0	1	1	1
0	1	0	0	1
0	1	1	1	0
1	0	0	1	0
1	0	1	0	0
1	1	0	1	1
1	1	1	0	1

09767902959003	2162	C
09767902028903	2068	C
09767902027503	24964	C
09767902107903	12917	C
09767901702903	35548	C
09767902668003	14812	C
09767902844003	2909	C
09767901704903	32419	C
Total	**149481**	

K-maps of D_A & D_B

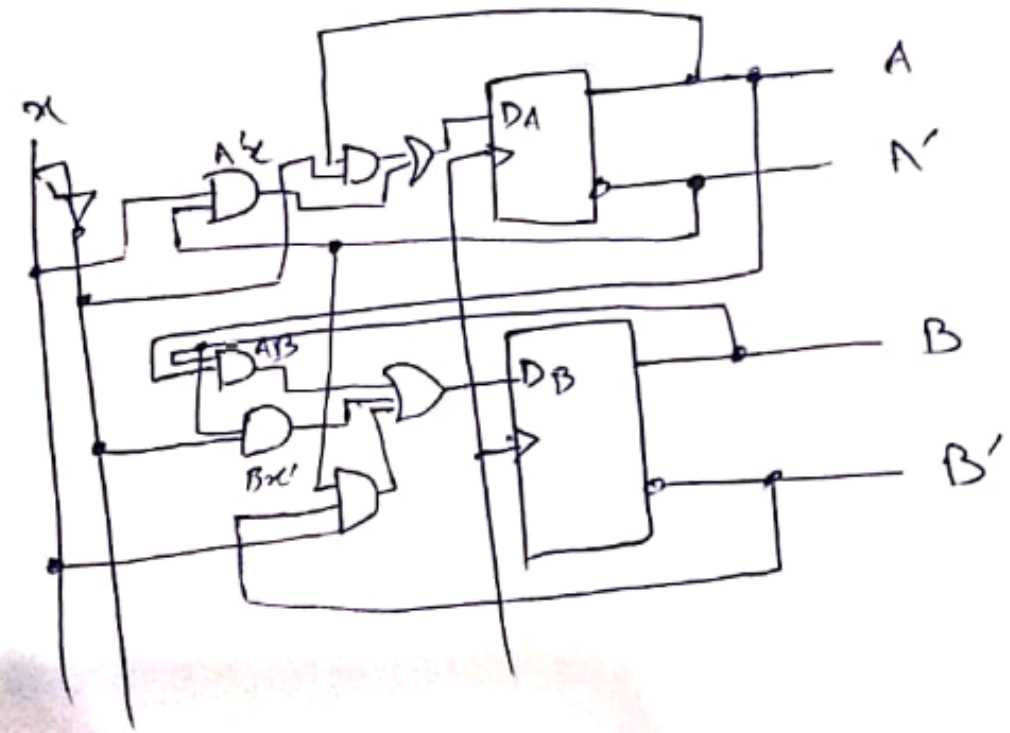
=

A \ Bx	00	01	11	10
0	0 (0)	1 (1)	1 (3)	0 (2)
1	1 (4)	0 (5)	0 (7)	1 (6)

$D_A = A'x + Ax' = A \oplus Bx$

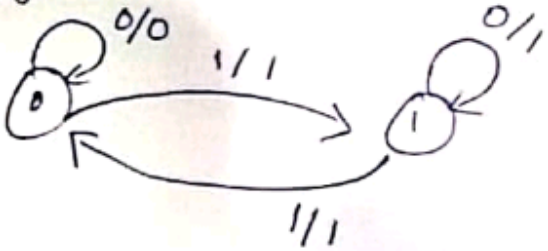
A \ Bx	00	01	11	10
0	0 (0)	1 (1)	0 (3)	1 (2)
1	0 (4)	0 (5)	1 (7)	1 (6)

$D_B = A'B'x + AB + Bx'$

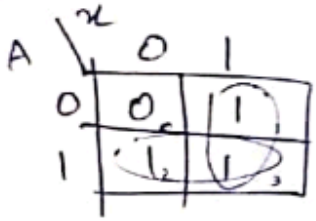


Present State A	Input x	Next State Q(t+1)	Output y
0	0	0	0
0	1	1	1
1	0	1	1
1	1	1	0

State Diagram

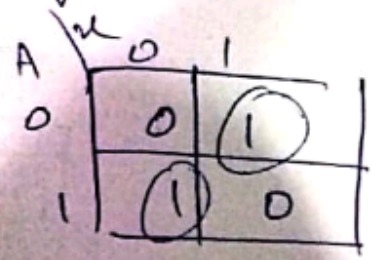


Kmap of A(t+1)



$D_A = A + x$

Kmap of output (y)

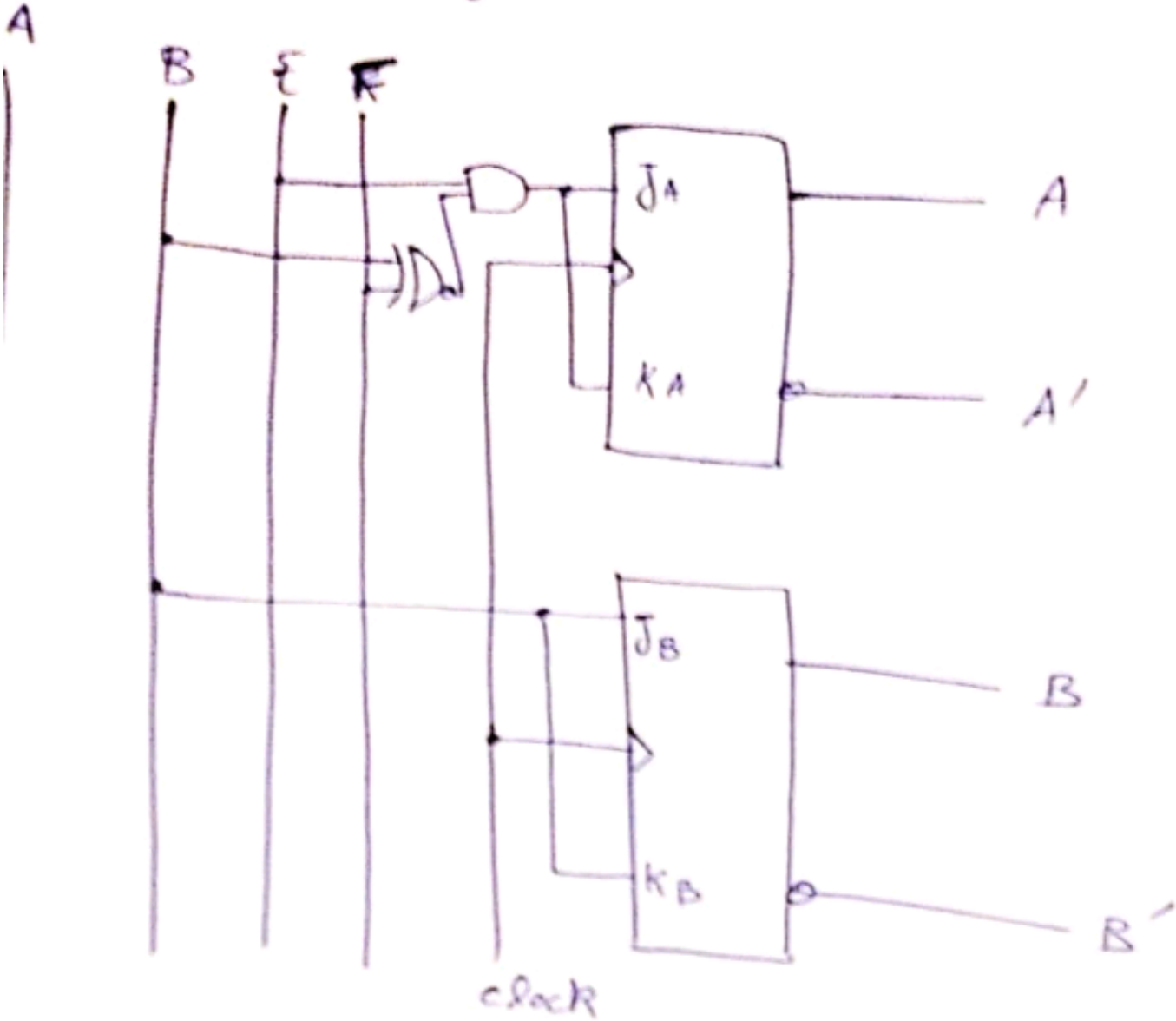


$y = Ax' + A'x$

$y = A \oplus x$

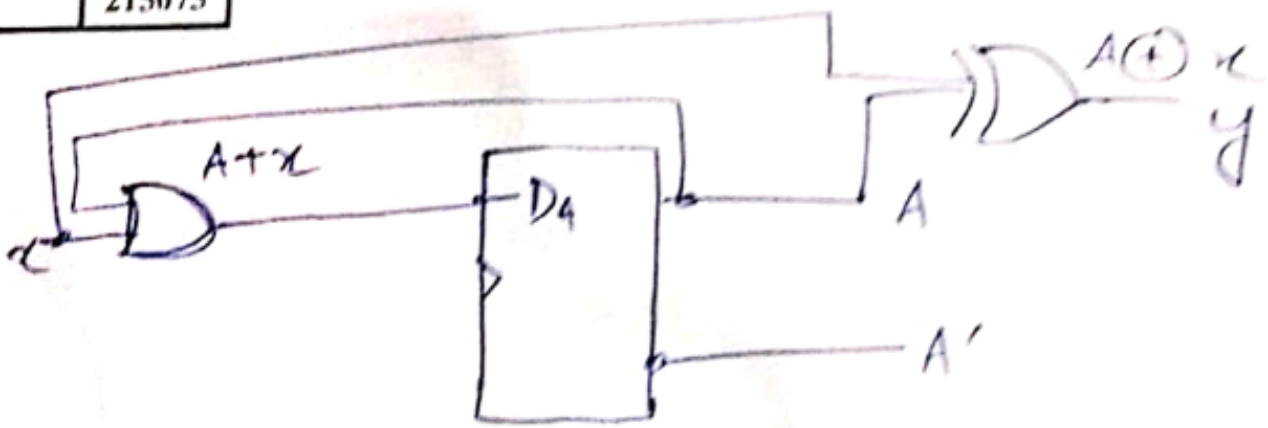
$D_B = A \oplus x$

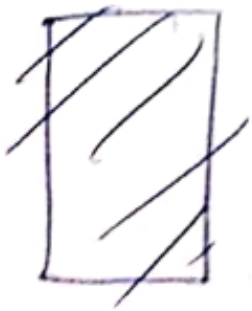
Circuit Diagram



767901776903	5834	C
767901714103	5943	C
767901715403	5211	C
767902109603	5211	C
767901706603	5527	C
Total	**215075**	

State Diagram:





(5.12)

If $E=0 \longrightarrow$ no change

If $E=1$ & $F=1 \longrightarrow$ transition

$00 \rightarrow 01$

$01 \rightarrow 10$

$10 \rightarrow 11$

If $E=1$ & $F=0 \longrightarrow$ transition

$00 \rightarrow 11$

$11 \rightarrow 10$

$10 \rightarrow 01$

Excitation table

Q	Q(t+1)	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

Input

A	B	E	F	$Q_A(t+1)$ Next State		$Q_B(t+1)$ Next State	J_A	K_A	J_B	K_B
0	0	0	0	0	0	0	0	X	0	X
0	0	0	1	0	1	0	0	X	0	X
0	0	1	0	1	2	1	1	X	1	X
0	0	1	1	0	3	0	0	X	1	X
0	1	0	0	0	4	1	0	X	X	0
0	1	0	1	0	5	1	0	X	X	0
0	1	1	0	0	6	0	0	X	X	1
0	1	1	1	1	7	0	1	X	X	1
1	0	0	0	1	8	0	X	0	0	X
1	0	0	1	1	9	0	X	0	0	X
1	0	1	0	0	10	1	X	1	1	X
1	0	1	1	1	11	1	X	0	1	X
1	1	0	0	1	12	1	X	0	X	0
1	1	0	1	1	13	1	X	0	X	0
1	1	1	0	1	14	0	X	0	X	1
1	1	1	1	0	15	0	X	1	X	1

K maps

J_A:

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

$$J_A = BEF + B'EF'$$
$$= E(BF + B'F')$$
$$= E(B \odot F)$$

K_A:

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

$$K_A = E(B \odot F)$$

J_B

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

$J_B = E$

K_B :

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

$K_B = E$

-(5.19)-

A	B	C	x	J_A	K_A	J_B	K_B	J_C	K_C	Next
0	0	0	0	X	1	X	1	X		011
0	0	0	1	1	X	0	X	0	X	100
0	0	1	0	0	X	0	X	X	0	001
0	0	1	1	1	X	0	X	X	1	100
0	1	0	0	0	X	X	0	0	X	010
0	1	0	1	0	X	X	1	0	X	000
0	1	1	0	0	X	X	1	X	0	001
0	1	1	1	0	X	X	0	X	1	010
1	0	0	0	X	1	1	X	0	X	010
1	0	0	1	X	1	1	X	1	X	011

– (5.20) –

A	B	C	x	Q(t+1) A	B	C	T_A	T_B	T_C
0	0	0	0	0	1	1	0	1	1
0	0	0	1	1	0	0	1	0	0
0	0	1	0	0	0	1	0	0	0
0	0	1	1	1	0	0	1	0	1
0	1	0	0	0	1	0	0	0	0
0	1	0	1	0	0	0	0	1	0
0	1	1	0	0	0	1	0	1	0
0	1	1	1	0	1	0	0	0	1
1	0	0	0	0	1	0	1	1	0
1	0	0	1	0	1	1	1	1	1

$T_A = A'B + Bx'$

$T_B = B'x' + A'x + A'Bx$

$T_C = Ax$