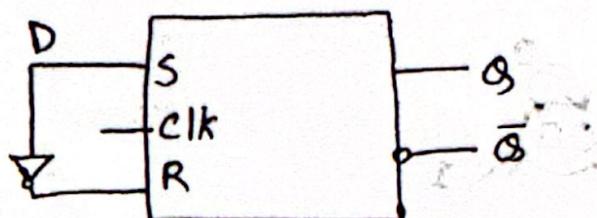
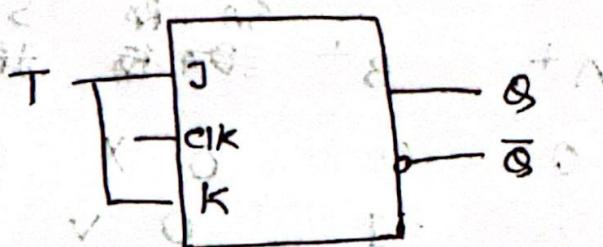


Assignment 1

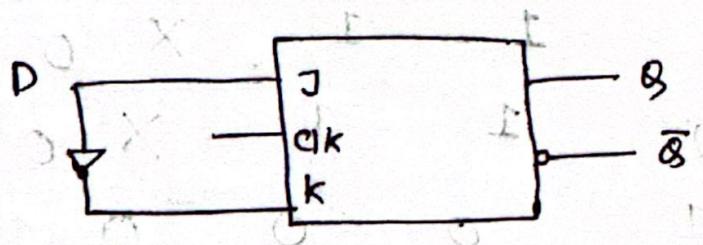
1. Design a D FF using SR FF



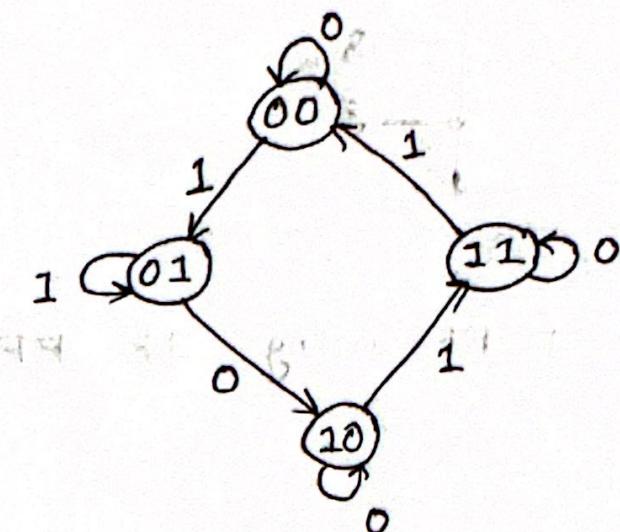
2. Design a T FF using JK FF.



3. Design a D FF using JK FF



④ Given the state diagram as follows, get the sequential circuit using SR flipflop.



A	B	α	A^+	B^+	SA	RA	SB	RB
0	0	0	0	0	0	X	0	X
0	0	1	0	1	0	X	1	0
0	1	0	1	0	1	0	0	1
0	1	1	0	1	0	X	X	0
1	0	0	1	0	X	0	0	X
1	0	1	1	1	X	0	1	0
1	1	0	1	1	X	0	X	0
1	1	1	0	0	0	1	0	1

SR flip-flop excitation table

$Q(t)$	$Q(t+1)$	S	R
0	0	0	X
0	1	1	0
1	0	0	1
1	1	X	0

$$S_A = \Sigma(2, 7, 4, 5, 6)$$

$$R_A = \Sigma(0, 1, 3, 7)$$

$$S_B = \Sigma(1, 3, 5, 6)$$

$$R_B = \Sigma(1, 3, 5, 8)$$

	$\bar{B}X$	BX	BX	$B\bar{X}$
\bar{A}	0	1	3	1
A	X	X	X	X
	4	5	7	6

$$S_A = B\bar{X}$$

	$\bar{B}X$	BX	BX	$B\bar{X}$
\bar{A}	X	X	X	1
A	0	1	3	2
	4	5	7	6

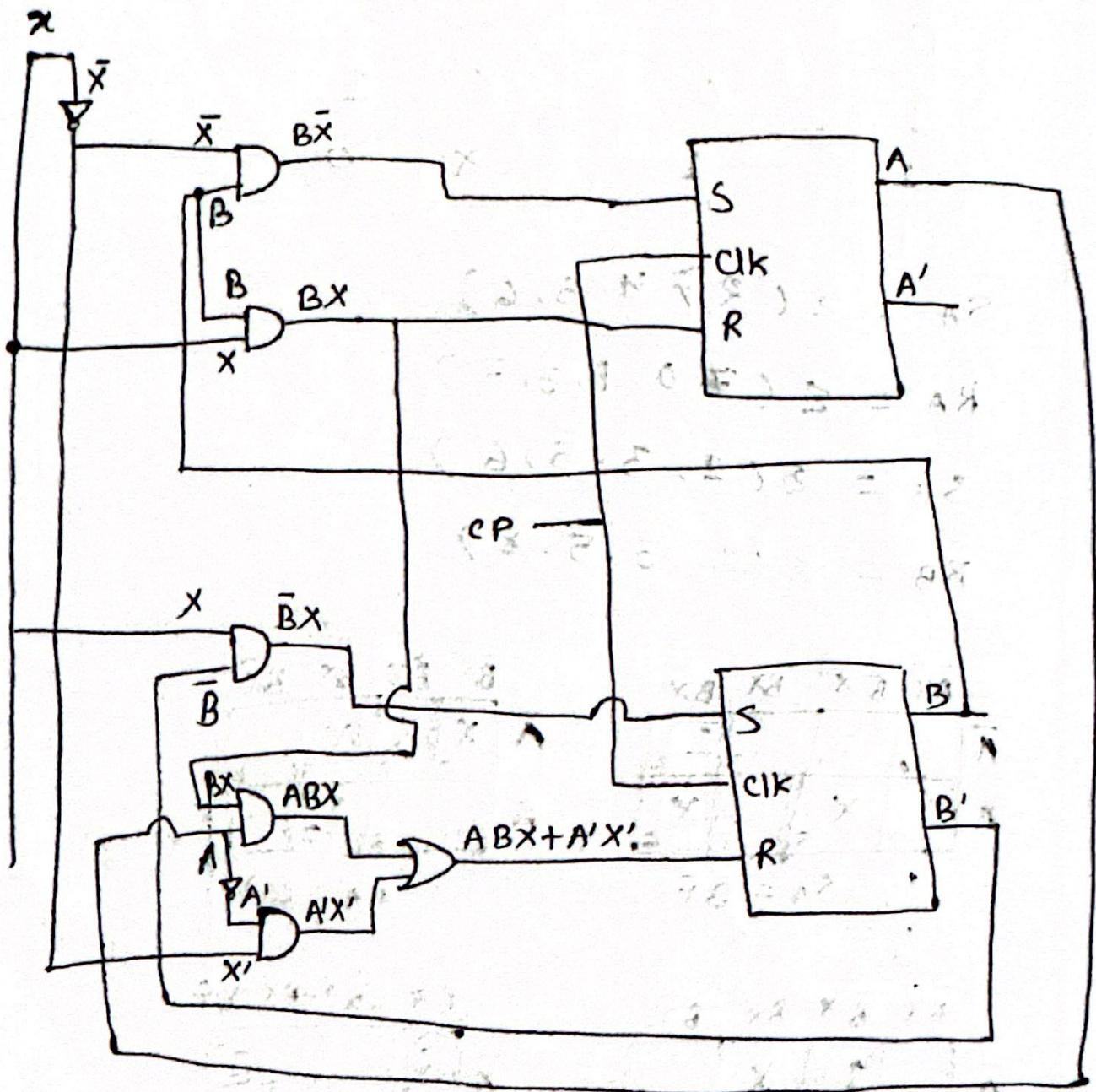
$$R_A = BX$$

	$\bar{B}X$	$\bar{B}X$	BX	$B\bar{X}$
\bar{A}	0	1	X	2
A	X	1	X	X
	4	5	7	6

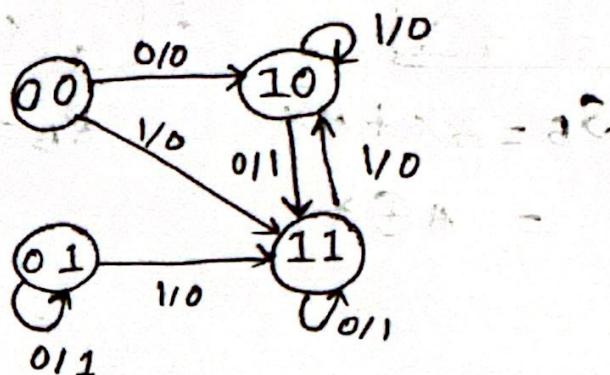
$$S_B = \bar{B}X$$

	$\bar{B}X$	$\bar{B}X$	BX	$B\bar{X}$
\bar{A}	X	1	3	1
A	0	1	3	2
	4	5	7	6

$$R_B = ABX + \bar{A}\bar{B}\bar{X}$$



⑤ Given the state diagram as follows, get the sequential circuit using SR flip-flop



A	B	x	A+	B+	y	S _A	R _A	S _B	R _B
0	0	0	1	0	0	1	0	0	x
0	0	1	1	1	0	1	0	1	0
0	1	0	0	1	1	0	x	x	0
-0	1	1	1	1	0	1	0	x	0
1	0	0	1	1	1	x	0	1	0
1	0	1	1	0	0	x	0	0	x
1	1	0	1	1	1	x	0	x	0
1	1	1	1	0	0	x	0	0	1

	$\bar{B}\bar{x}$	$\bar{B}x$	Bx	$B\bar{x}$
\bar{A}	0	1	2	3
A	4	5	7	6

	$\bar{B}\bar{x}$	$\bar{B}x$	Bx	$B\bar{x}$
\bar{A}	0	1	2	3
A	4	5	7	6

	$\bar{B}\bar{x}$	$\bar{B}x$	Bx	$B\bar{x}$
\bar{A}	0	1	3	x
A	4	5	7	6

$$R_A = 0$$

$$y = A\bar{B}\bar{x} + B\bar{x}$$

$$S_A = \bar{B} + x$$

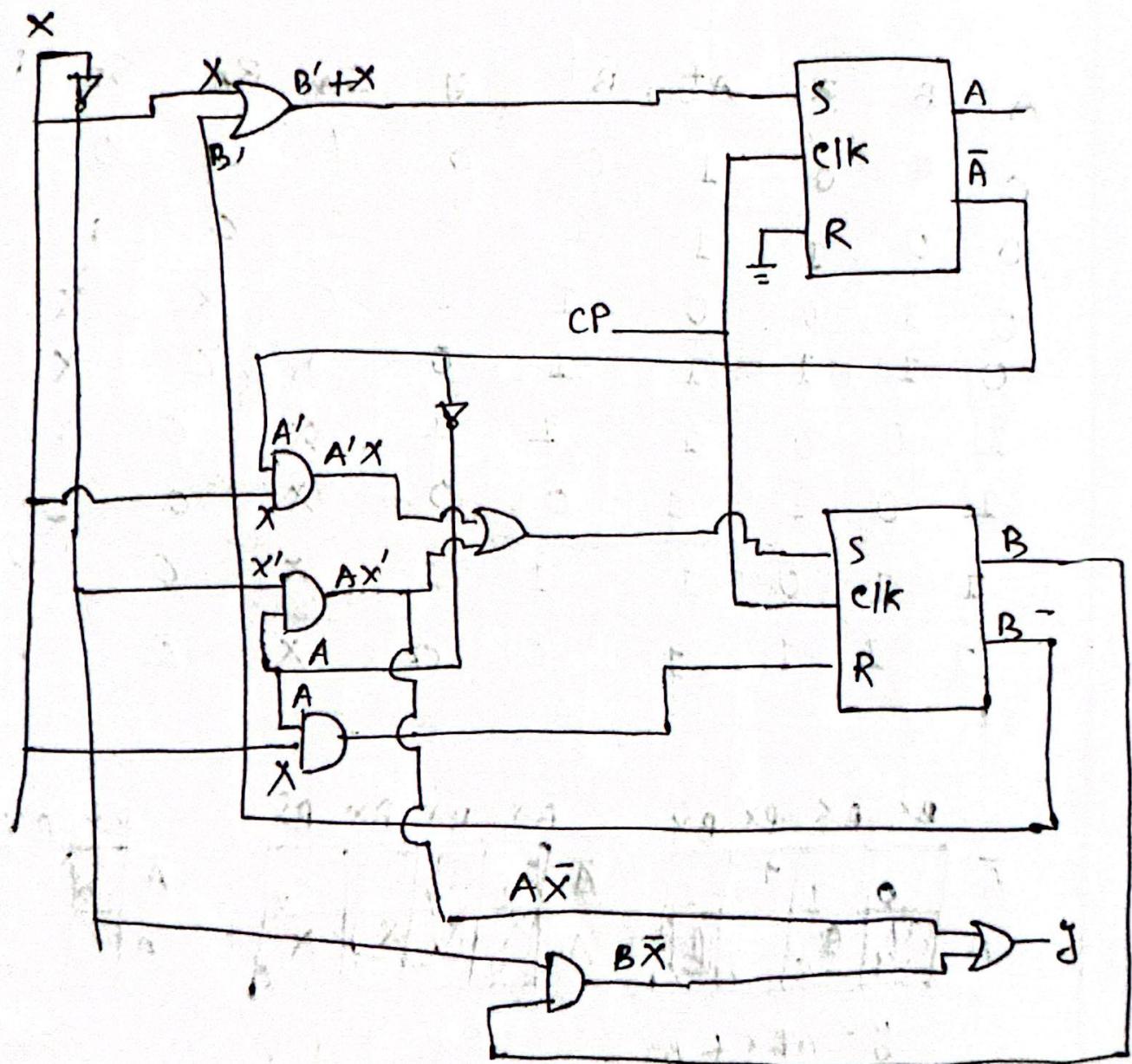
$$\begin{array}{c} \bar{B}\bar{X} \quad \bar{B}X \quad BX \quad B\bar{X} \\ \bar{A} \quad | \quad 0 \quad | \quad 1 \quad | \quad X_3 \quad | \quad X_2 \\ A \quad | \quad 1 \quad | \quad 5 \quad | \quad 7 \quad | \quad X_6 \end{array}$$

$$S_B = \bar{A}X + A\bar{X}$$

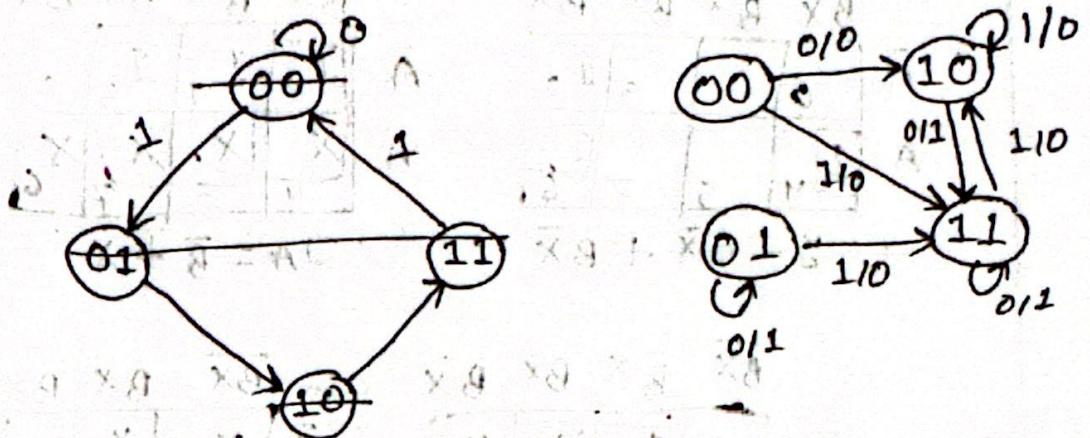
$$= A \oplus X$$

$$\begin{array}{c} \bar{B}\bar{X} \quad \bar{B}X \quad BX \quad B\bar{X} \\ \bar{A} \quad | \quad X_0 \quad | \quad 1 \quad | \quad 3 \quad | \quad 2 \\ A \quad | \quad X_5 \quad | \quad 1 \quad | \quad 7 \quad | \quad 6 \end{array}$$

$$R_B = AX$$



ii) Using JK flip flop



A	B	χ	A+	B+	y	J _A	K _A	J _B	K _B
0	0	0	1	0	0	1	x	0	x
0	0	1	1	1	0	1	x	1	x
0	1	0	0	1	1	0	x	x	0
0	1	1	1	1	0	1	x	x	0
1	0	0	1	1	1	x	0	1	x
1	0	1	1	0	0	x	0	0	x
1	1	0	1	1	1	x	0	x	0
1	1	1	1	0	0	x	0	x	1

JK excitation table

$\theta(+)$	$\theta(+-)$	J	K
0	0	0	x
0	1	1	x
1	0	x	1
1	1	x	0

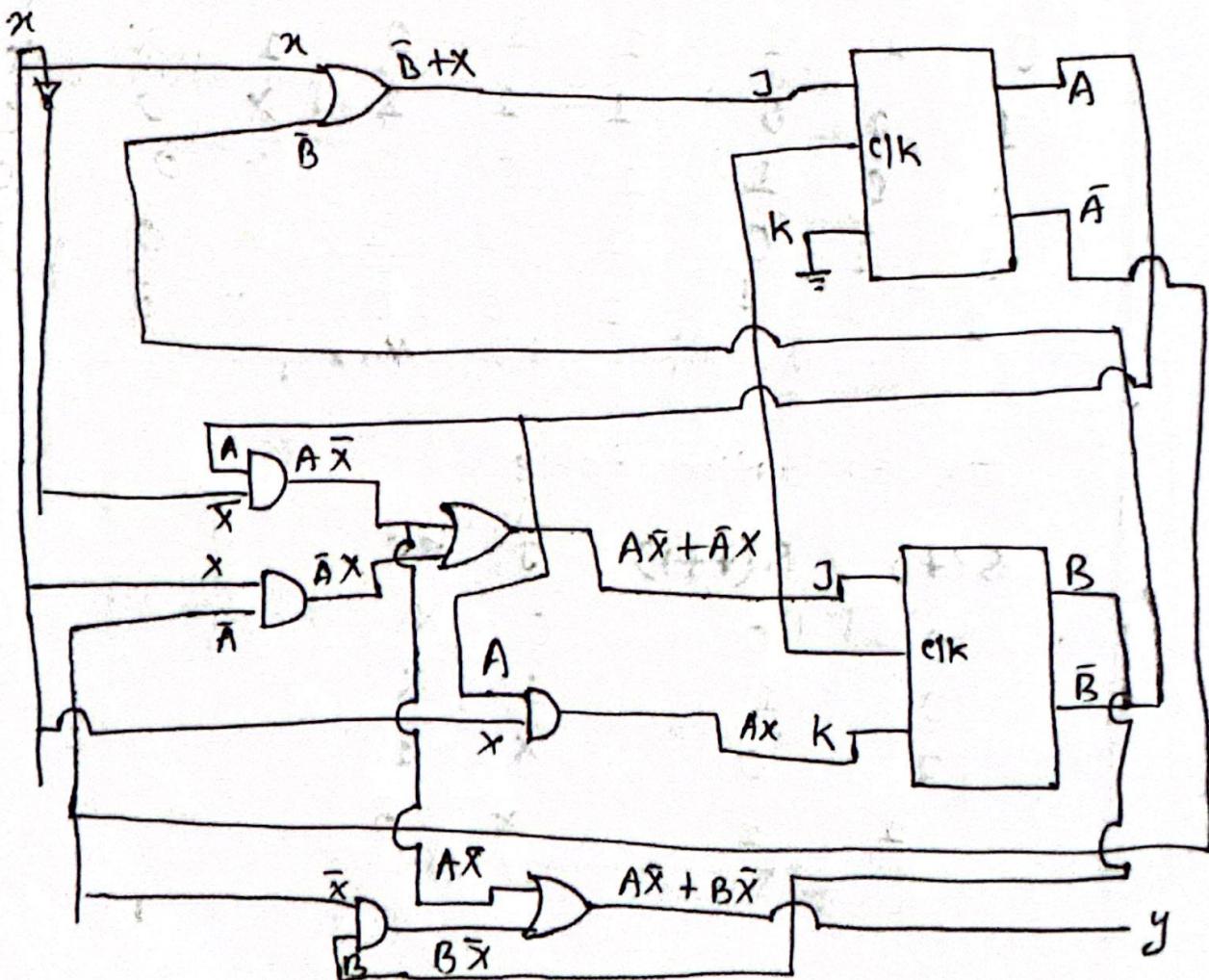
	$\bar{B}X$	$\bar{B}X$	BX	$B\bar{X}$
\bar{A}	0	1	3	2
A	1	4	5	7
	$y = A\bar{X} + B\bar{X}$			

	$\bar{B}X$	$\bar{B}X$	BX	$B\bar{X}$
\bar{A}	1	0	1	2
A	X	X	X	X
	$J_A = \bar{B} + X$			

	$\bar{B}X$	$\bar{B}X$	BX	$B\bar{X}$
\bar{A}	X	X	X	X
A	0	1	3	2
	$KA = 0$			

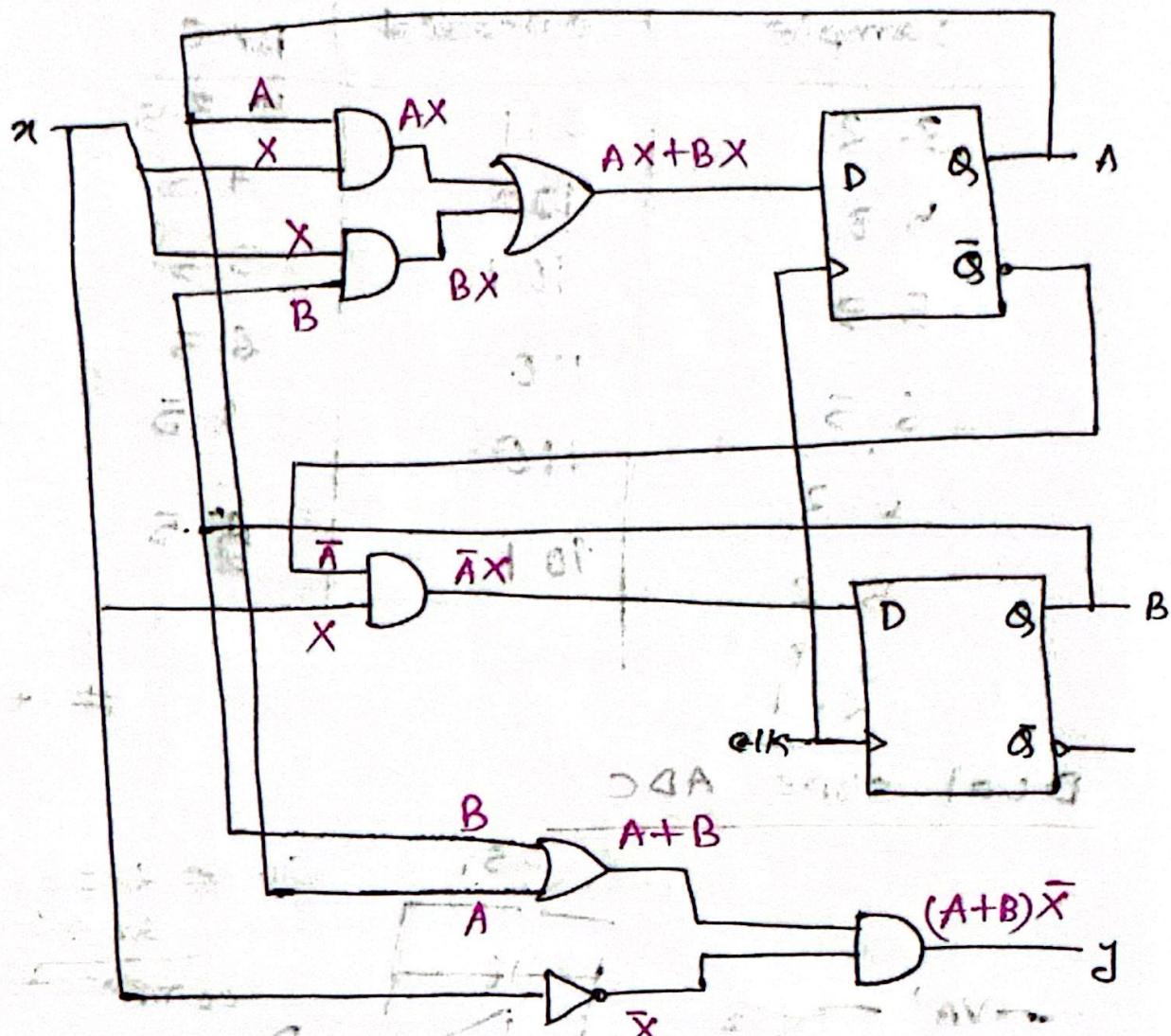
	$\bar{B}X$	$\bar{B}X$	BX	$B\bar{X}$
\bar{A}	0	1	X	2
A	1	4	X	6
	$J_B = A\bar{X} + \bar{A}X$			

	$\bar{B}X$	$\bar{B}X$	BX	$B\bar{X}$
\bar{A}	X	0	1	2
A	X	4	5	7
	$K_B = AX$			



Assignment 4

⑥



i) 2 flip flops are there

$$D_a : A \bar{x} + Bx$$

$$D_b : \bar{A}x$$

$$Y : (A+B)\bar{x}$$

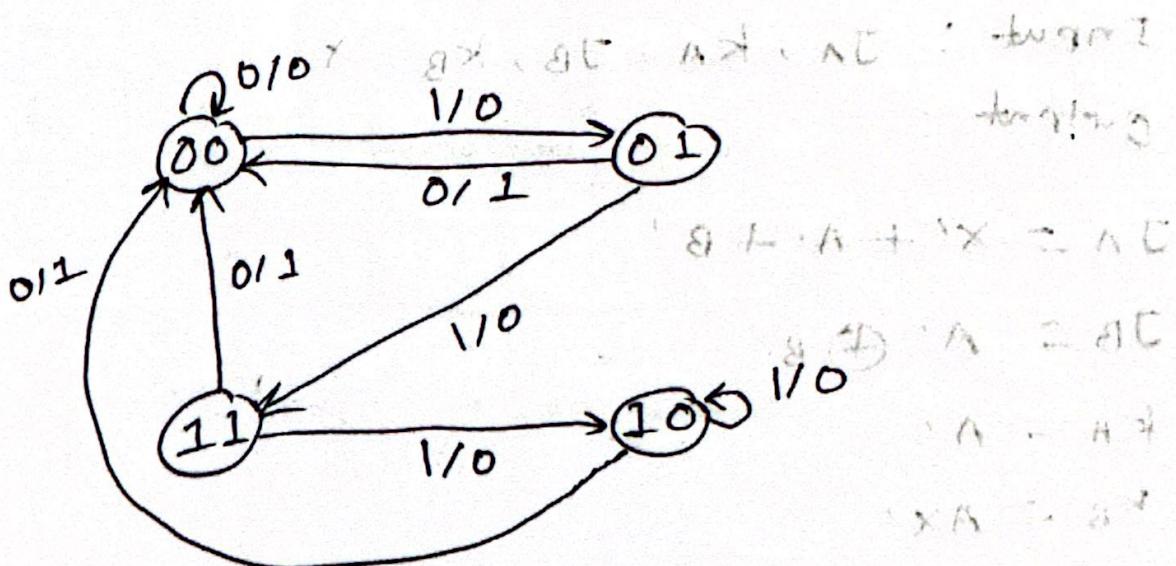
State table

A	B	x	D _a	D _b	y	A ⁺	B ⁺
0	0	0	0	0	0	0	0
0	0	1	0	1	0	0	1
0	1	0	0	0	1	0	0
0	1	1	1	1	0	1	1
1	0	0	0	0	1	0	0
1	0	1	1	0	0	1	0
1	1	0	0	0	1	0	0
1	1	1	1	0	0	1	0

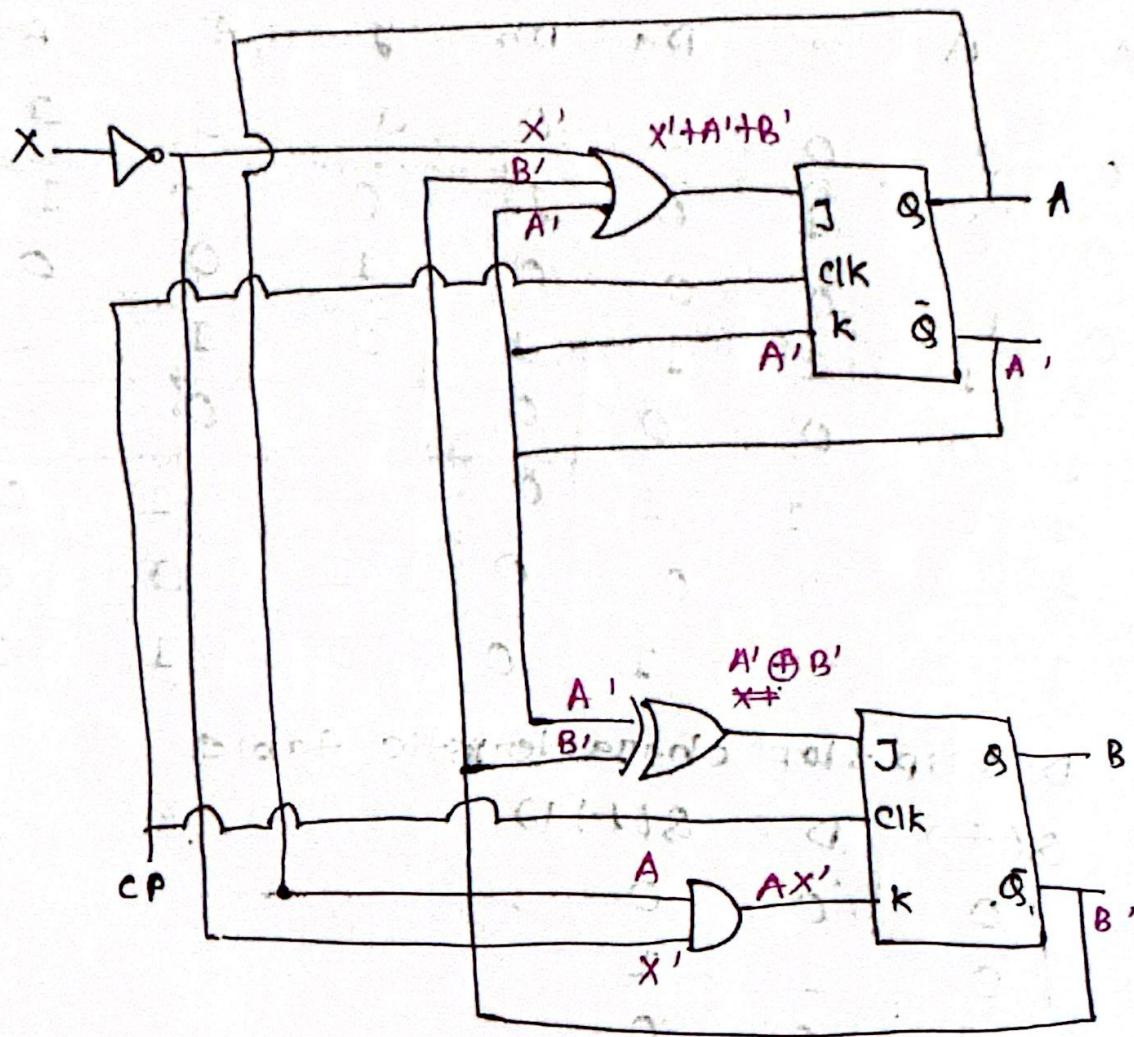
D flip-flop characteristic table

$Q(+)$	D	$Q(+) + 1$
0	0	0
0	1	1
1	0	0
1	1	1

state diagram: g. + A : state transition



(7)



Present state : A, B

Next state : A+, B+

Input : J_A, K_A, J_B, K_B, X

Output :

$$JA = X' + A' + B'$$

$$JB = A' \oplus B'$$

$$KA = A'$$

$$KB = AX'$$

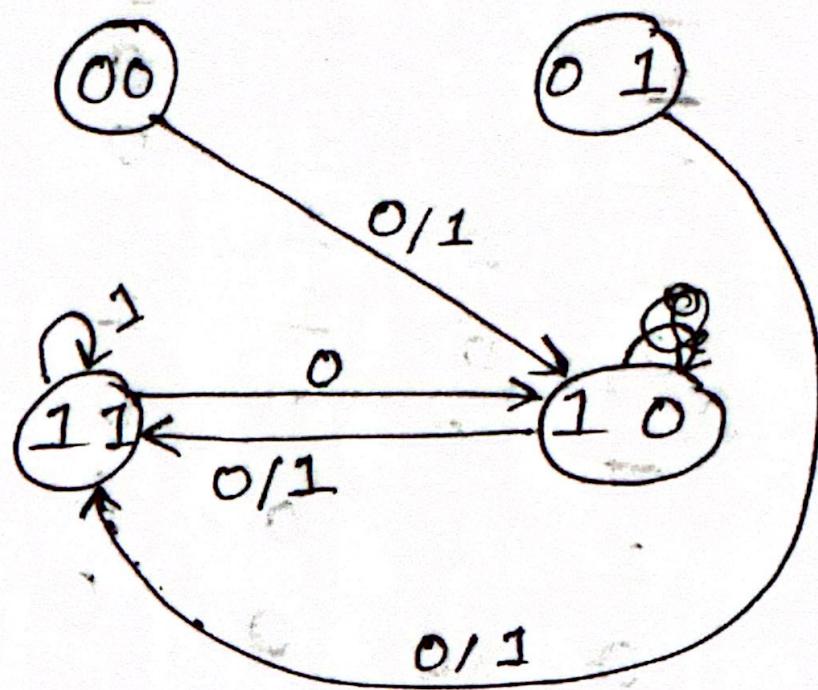
State table

A	B	x	J _A	K _A	J _B	K _B	A ⁺	B ⁺
0	0	0	1	1	0	0	1	0
0	0	1	1	1	0	0	1	0
0	1	0	1	1	1	0	1	1
0	1	1	1	1	1	0	1	1
1	0	0	1	0	1	1	1	01
1	0	1	1	0	1	0	1	1
1	1	0	1	0	0	1	1	0
1	1	1	0	0	0	0	1	1

JK characteristic table

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

State diagram :



⑧

CSE 110 → 000

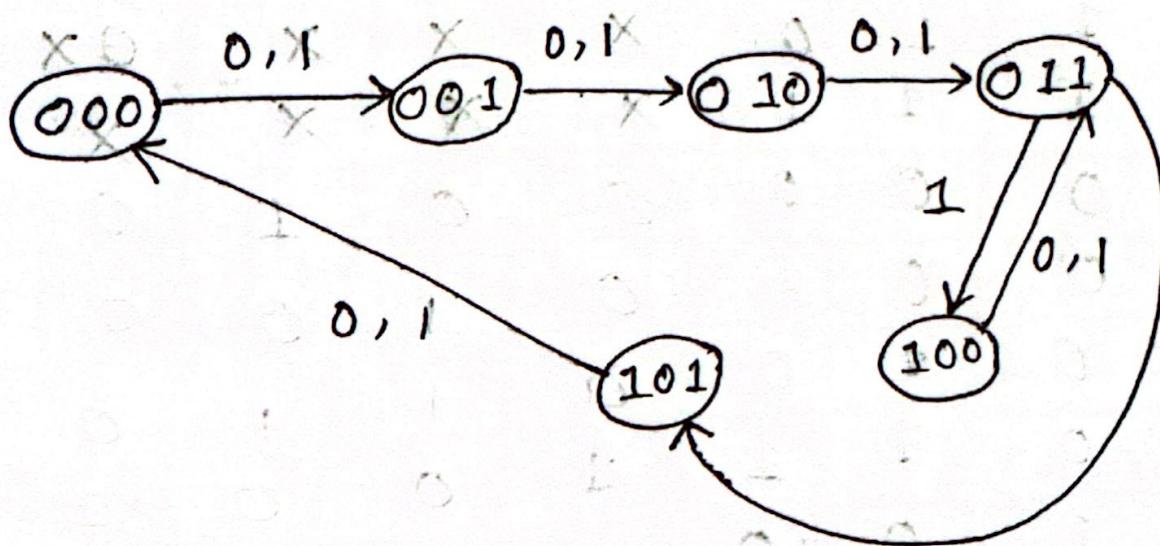
CSE 111 → 001

CSE 220 → 010

CSE 221 → 011

CSE 331 → 100

CSE 321 → 101



x	A	B	C	A^+	B^+	C^+	T_A	T_B	T_C
0	0	0	0	0	0	1	0	0	1
0	0	0	1	0	1	0	0	1	1
0	0	1	0	0	1	1	0	0	1
0	0	1	1	1	0	1	1	1	0
0	1	0	0	0	1	1	1	1	1
0	1	0	1	0	0	0	1	0	1
0	1	1	0	X	X	X	0X	X	X
0	1	1	1	X	X	X	X	X	X
1	0	0	0	0	0	1	0	0	1
1	0	0	1	0	1	0	0	1	1
1	0	1	0	0	1	1	0	0	1
1	0	1	1	1	0	0	1	1	1
1	1	0	0	0	1	1	1	1	1
1	1	0	1	0	0	0	1	0	1
1	1	1	0	X	X	X	X	X	X
1	1	1	1	X	X	X	X	X	X

$$T_A = \{3, 4, 5, 11, 12, 13\}$$

$$T_B = \{1, 3, 4, 9, 11, 12\}$$

$$T_C = \{0, 1, 2, 4, 5, 8, 9, 10, 11, 12, 13\}$$

$\bar{x}A$	BC	$B'C'$	$B'C$	BC	BC'	
$x'A'$	0	1	1	3	2	
$\bar{x}'A$	1	4	1	5	x_7	x_6
$\bar{x}A$	1	12	1	13	x_7	x_6
$x'A'$	8	9	1	11	10	

$$T_A = A + BC$$

$\bar{x}A$	BC	$B'C'$	$B'C$	BC	BC'	
$x'A'$	0	1	1	1	2	
$\bar{x}'A$	1		5	x_7	x_6	
$\bar{x}A$	1	12	1	13	x_7	x_6
$x'A'$	8	1	9	1	11	10

$$\begin{aligned}
 T_B &= A' C + \cancel{B C} \\
 &\quad + A C' \\
 &= (A \oplus C) + \cancel{B C}
 \end{aligned}$$

$\bar{x}A$	BC	$B'C'$	$B'C$	BC	BC'	
$x'A'$	1	0	1	3	2	
$\bar{x}'A$	1		1	x_7	x_6	
$\bar{x}A$	1	12	1	13	x_7	x_6
$x'A'$	8	1	9	1	11	10

$$\begin{aligned}
 T_C &= B' + A \\
 &\quad + C' + x
 \end{aligned}$$

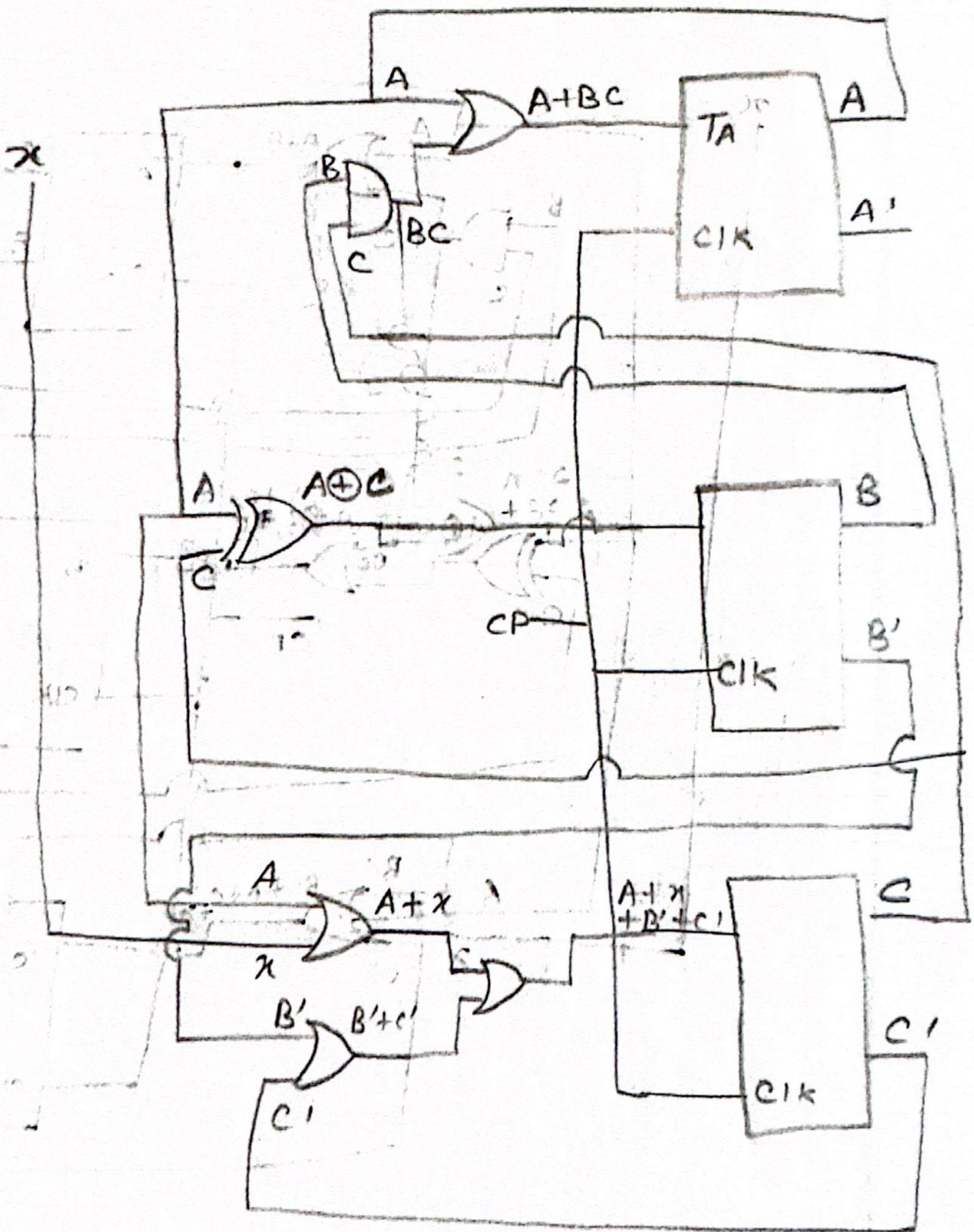
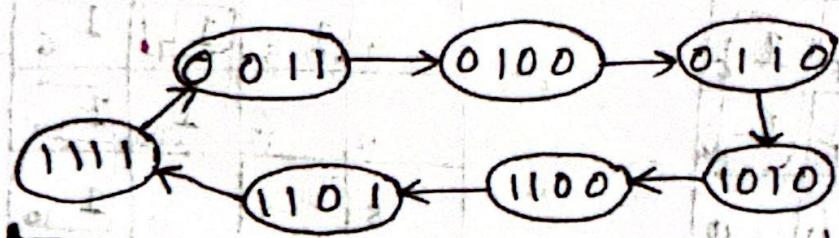


table
kmap
circuit diagram

$$(9) \quad 3 \rightarrow 4 \rightarrow 6 \rightarrow 10 \rightarrow 12 \rightarrow 13 \rightarrow 15 \rightarrow 3$$

$\downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow \quad \downarrow$

0011 0100 0110 1010 1100 1101 1111 0011



A ₃	A ₂	A ₁	A ₀	A ₃ ⁺	A ₂ ⁺	A ₁ ⁺	A ₀ ⁺	T _{A₃}	T _{A₂}	T _{A₁}	T _{A₀}
0	0	0	0	0	0	1	1	0	0	1	1
0	0	0	1	0	0	1	1	0	0	1	0
0	0	1	0	0	0	1	1	0	0	0	1
0	0	1	1	0	1	0	0	0	1	1	1
0	1	0	0	0	1	1	0	0	0	0	0
0	1	0	1	0	0	1	1	0	1	1	0
0	1	1	0	1	0	1	0	1	1	0	0
0	1	1	1	0	0	1	1	0	0	0	0
1	0	0	0	0	0	1	1	1	0	1	1
1	0	0	1	0	0	1	1	1	0	1	0
1	0	1	0	1	1	0	0	0	1	1	0
1	1	0	1	1	1	1	1	0	0	0	1
1	1	1	0	0	0	1	1	1	1	0	0
1	1	1	1	0	0	1	1	1	1	0	0

$A_3 A_2$	$A_1 A_0$	$\bar{A}_1 \bar{A}_0$	$\bar{A}_1 A_0$	$A_1 A_0$	$A_1 \bar{A}_0$
$\bar{A}_3 \bar{A}_2$	0	1	3	2	
$\bar{A}_3 A_2$	4	5	7	1	6
$A_3 A_2$	8	13	15	14	
$A_3 \bar{A}_2$	1	0	1	1	10

$$T_{A_3} = A_3 \bar{A}_2 + A_1 A_0 + A_1 \bar{A}_0$$

$\bar{A}_1 \bar{A}_0 \quad \bar{A}_1 A_0 \quad A_1 A_0 \quad A_1 \bar{A}_0$

$\bar{A}_3 \bar{A}_2$	1	0	1	3	2
$\bar{A}_3 A_2$	1	1	5	7	6
$A_3 A_2$	12	1	3	15	14
$A_3 \bar{A}_2$	1	0	1	1	10

$$T_{A_1} = \bar{A}_3 \bar{A}_1 + \bar{A}_1 A_0$$

$$+ A_3 \bar{A}_2 \bar{A}_0 + \bar{A}_3 \bar{A}_2 A_0$$

0	1	1	3	2
4	1	5	1	6
12	13	1	15	14
8	9	11	1	10

$$T_{A_2} = A_1 A_2 + A_3 \bar{A}_2 A_1$$

$$+ \bar{A}_3 A_2 A_0 + A_1 A_0 \bar{A}_1$$

1	0	1	3	2
4	5	7	6	
1	12	13	15	14
1	8	9	11	10

$$T_{A_0} = A_3 A_1 \bar{A}_0$$

$$+ \bar{A}_3 \bar{A}_2 A_1$$

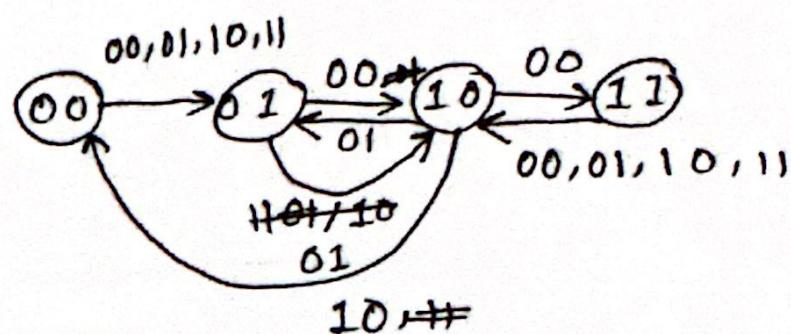
$$+ \bar{A}_3 \bar{A}_2 \bar{A}_0$$

$$+ A_3 A_2 \bar{A}_0$$

10

A	B	C	D	$A +$	$B +$	$C +$	$D +$	J_A	K_A	J_B	K_B	J_C	K_C	J_D	K_D
0	0	0	0	0	0	0	1	0	X	0	X	0	X	1	X
0	0	0	1	0	0	1	0	0	X	0	X	1	X	X	1
0	0	1	0	0	0	1	1	0	X	0	X	X	0	1	X
0	0	1	1	0	0	1	0	0	X	1	X	X	1	X	1
0	1	0	0	0	1	0	1	0	X	X	0	0	X	1	X
0	1	0	1	0	1	1	0	0	X	X	0	1	X	X	1
0	1	1	0	0	1	1	1	0	X	X	0	X	0	1	X
0	1	1	1	1	0	0	0	1	X	X	1	X	1	X	1
1	0	0	0	1	0	0	1	X	0	0	X	0	X	1	X
1	0	0	1	1	0	1	0	X	0	0	X	1	X	X	1
1	0	1	0	1	0	1	1	X	0	0	X	X	0	1	X
1	0	1	1	1	1	0	0	X	0	1	X	X	1	X	1
1	1	0	0	1	1	1	0	1	X	0	X	0	0	X	1
1	1	0	1	1	1	1	0	0	X	0	X	0	1	X	X
1	1	1	0	1	1	1	1	1	X	0	X	0	X	0	1
1	1	1	1	1	0	0	0	0	X	1	X	1	X	1	X

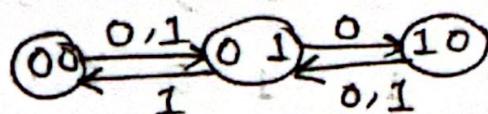
(12) Green \rightarrow Orange \rightarrow yellow \rightarrow red \rightarrow yellow \rightarrow orange
 ↓ ↓ ↓ ↓
 00 01 10 11 \rightarrow yellow \rightarrow green



x	y	A	B	A^+	B^+	T_A	T_B
0	0	0	0	0	1	0	1
0	0	0	1	1	0	1	1
0	0	1	0	1	1	0	1
0	0	1	1	1	0	0	1
0	1	0	0	0	1	0	1
0	1	0	1	1	0	1	1
0	1	1	0	0	1	1	1
0	1	1	1	1	0	0	1
1	0	0	0	0	1	0	1
1	0	0	1	1	0	1	1
1	0	1	0	0	0	1	0
1	0	1	1	1	0	0	01
1	1	0	0	0	1	0	1
1	1	0	1	1	0	1	1
1	1	1	0	0	0	0	0
1	1	1	1	1	0	0	1
1	2	1	1	1	0	0	1

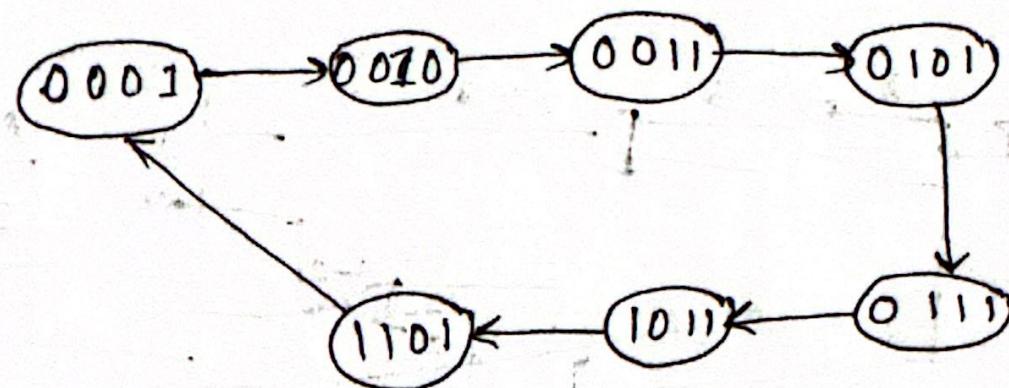
(13)

Green \rightarrow Yellow \rightarrow Red \rightarrow yellow \rightarrow Green



m	A	B	A^+	B^+	J_A	K_A	J_B	K_B
0	0	0	0	1	0	X	1	X
0	0	1	1	0	1	X	X	1
0	1	0	0	1	X	1	1	X
0	1	1	X	X	X	X	X	X
1	0	0	0	1	0	X	1	X
1	0	1	0	0	0	X	X	1
1	1	0	0	1	X	1	1	X
1	1	1	X	X	X	X	X	X

(11) $1 \rightarrow 2 \rightarrow 3 \rightarrow 5 \rightarrow 7 \rightarrow 11 \rightarrow 13 \rightarrow 1$



A	B	C	D	A^+	B^+	c^+	D^+	J_A	K_A	J_B	K_B	J_C	K_C	J_D	K_D	
0	0	0	0	0	0	0	1	0	x	0	x	0	x	1	x	
0	0	0	1	0	0	1	0	0	x	0	x	1	x	x	1	
0	0	1	0	0	0	1	1	0	x	0	x	x	x	0	1	x
0	0	1	1	0	1	0	1	0	x	1	x	x	x	1	x	0
0	1	0	0	0	0	0	1	0	x	x	x	1	0	x	1	x
0	1	0	1	0	1	1	1	0	x	x	0	1	x	x	0	0
0	1	1	0	0	0	0	1	0	x	x	1	x	1	x	1	x
0	1	1	1	1	1	0	1	1	x	x	1	x	0	x	0	0
1	0	0	0	0	0	0	1	x	1	0	x	0	x	1	x	1
1	0	0	1	0	0	0	1	x	1	0	x	0	x	0	x	0
1	0	1	0	0	0	0	1	x	1	0	x	x	1	1	x	1
1	0	1	1	1	1	0	0	1	x	0	1	x	x	1	x	0
1	1	0	0	0	0	1	1	x	1	x	1	1	x	1	x	1
1	1	0	1	0	0	0	1	x	1	x	1	0	x	x	0	0
1	1	1	0	0	0	0	1	x	1	x	1	x	1	x	1	x
1	1	1	1	0	0	0	0	1	x	1	x	1	x	1	x	0