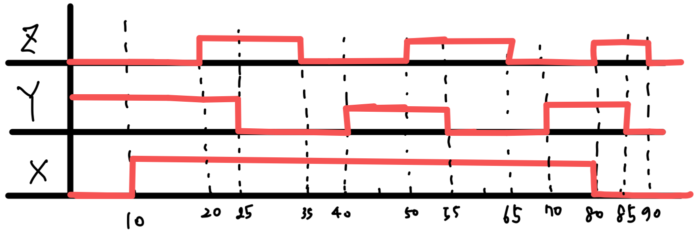
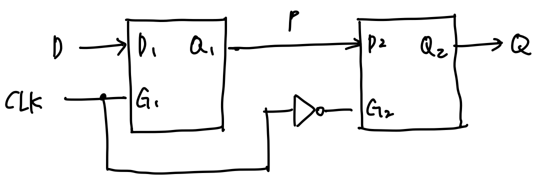
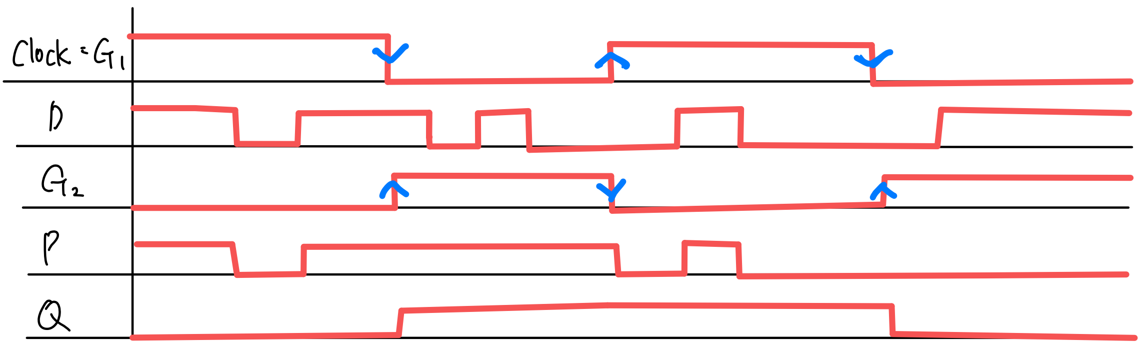
Report 4   2016314364 박수헌

11.1>

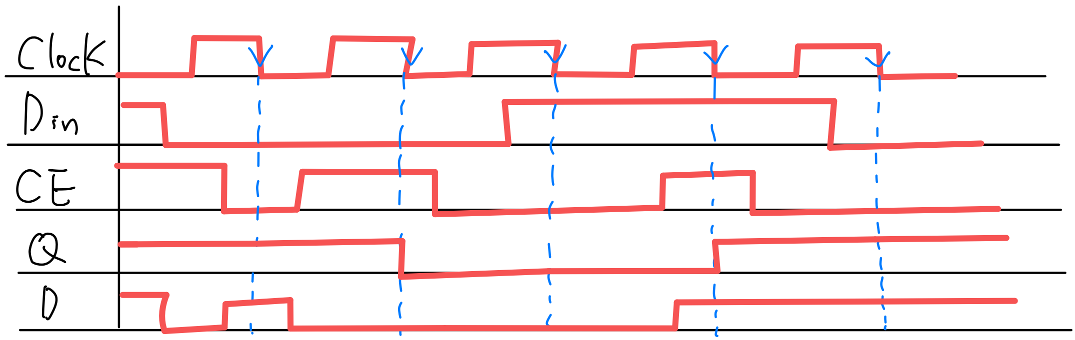


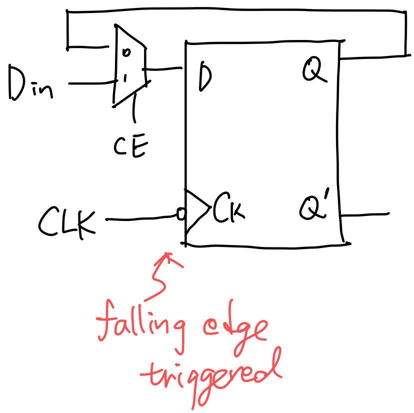
11.5> To make Figure 11-19(a) to implement a falling-edge-triggered D flip-flop, inverter must be connected to second D Latch as below





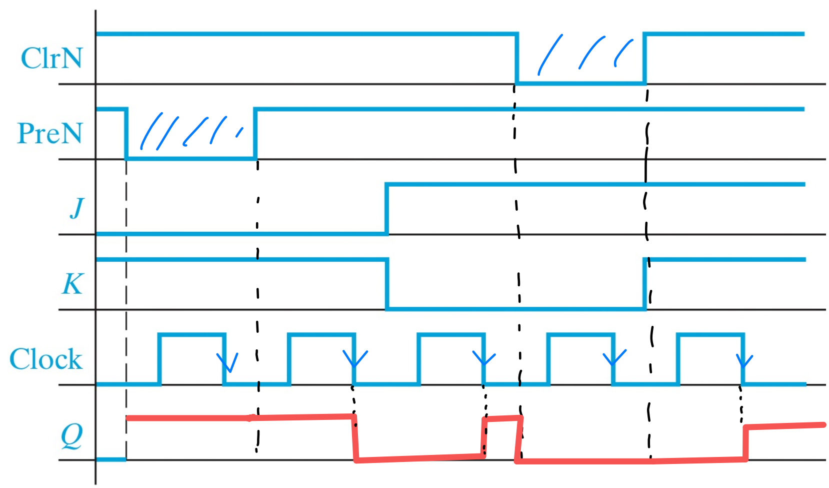
11.8)



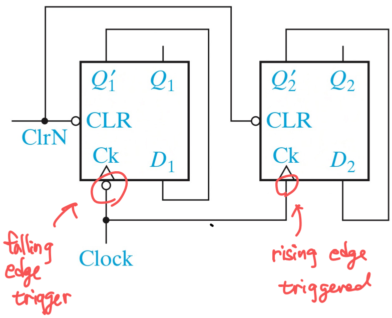


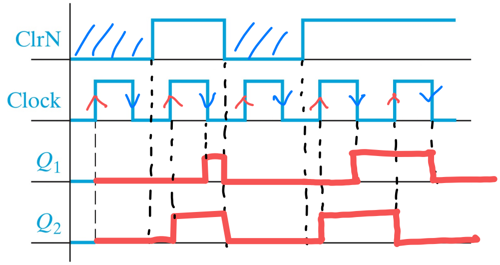
11.9) a) falling edge trigger

$Q^+ = JQ' + K'Q$



b)





11.(1) a)

S	R	Q	Q^+
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	(Not allowed) X
1	1	1	(Not allowed) X

RQ \ S	0	1
00	0	1
01	1	1
11	0	X
10	0	X

$Q' = S + R'Q$

$= (S+R')(S+Q)$

b) Gated D latch

G	D	Q
0	X	no change
1	0	Reset
1	1	Set

G	D	Q	Q^+
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	0
1	1	0	1
1	1	1	1

DQ \ G	0	1
00	0	0
01	1	0
11	1	1
10	0	1

$Q^+ = G'Q + GD = (G+Q)(G'+D)$

c) D flip-flop

D	Q
0	reset
1	set

D	Q	Q^+
0	0	0
0	1	0
1	0	1
1	1	1

$Q^+ = D$

d) D-CE flip-flop

CE	D	Q
0	X	no change
1	0	reset
1	1	set

CE	D	Q	Q^+
0	X	0	0
0	X	1	1
1	0	1	0
1	1	0	1
1	1	1	1

DQ \ CE	0	1
00	0	0
01	1	0
11	1	1
10	0	1

$$Q^+ = CE'Q + CE\,D$$
$$= (CE'+D)(CE+Q)$$

e) J-K flip-flop

J	K	Q
0	0	no change
0	1	0
1	0	1
1	1	negation

J	K	Q	Q^+
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

KQ \ J	0	1
00	0	1
01	1	1
11	0	0
10	0	1

$$Q^+ = K'Q + JQ'$$
$$= (Q+J)(Q'+K')$$

f) T flip-flop

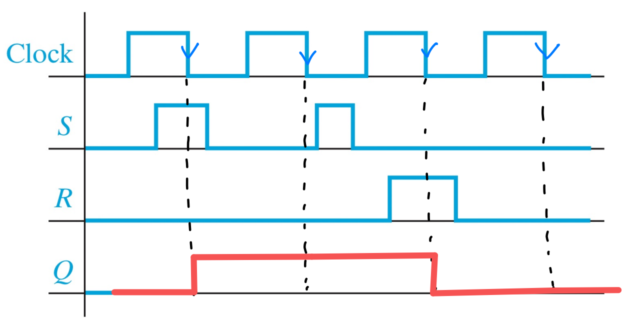
T	Q
0	no change
1	negation

T	Q	Q^+
0	0	0
0	1	1
1	0	1
1	1	0

$$Q^+ = T'Q + TQ'$$
$$= (T'+Q')(T+Q)$$

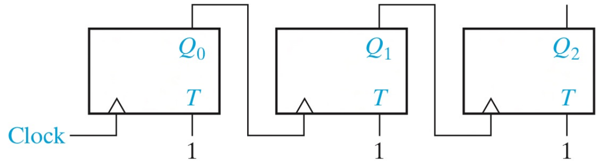
11.21> Q begins at 0 / falling edge triggered / $Q' = (S+R')(S+Q)$

$= S + R'Q$

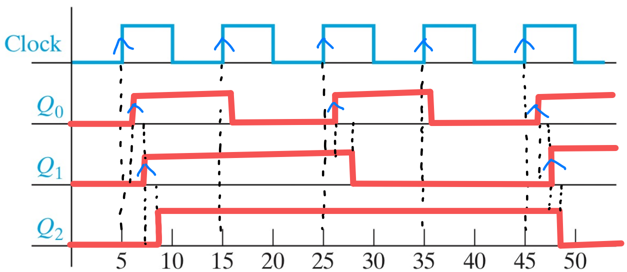


11.24) 3-bit ripple counter

$Q_0 = Q_1 = Q_2 = 0$ $(t=0)$ / FF delay : 1 ns

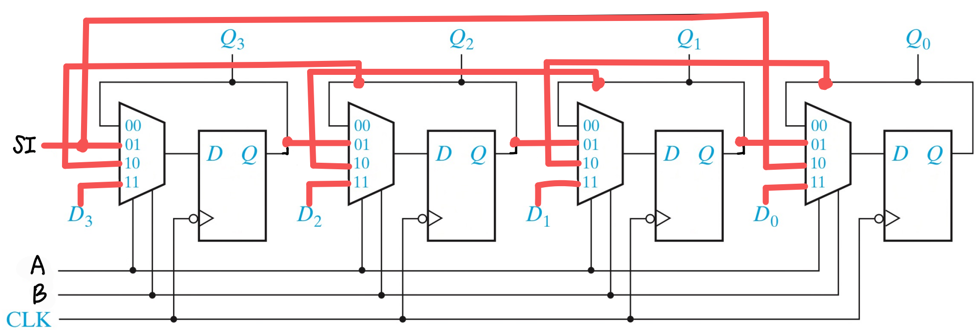


→ rising edge triggered

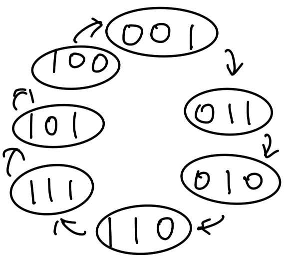


12.3)

Inputs		Next State				Action
A	B	Q_3^+	Q_2^+	Q_1^+	Q_0^+	
0	0	Q_3	Q_2	Q_1	Q_0	no change
0	1	SI	Q_3	Q_2	Q_1	right shift
1	0	Q_2	Q_1	Q_0	SI	left shift
1	1	D_3	D_2	D_1	D_0	load



12.8)



a	b	c	d	e	f
0	0	1	0	1	1
0	1	0	1	1	0
0	1	1	0	1	0
1	0	0	0	0	1
1	0	1	1	0	0
1	1	0	1	1	1
1	1	1	1	0	1

a) Use J-K flip-flops

a	b	c	d	e	f	J_a	K_a	J_b	K_b	J_c	K_c
0	0	0	x	x	x	x	x	x	x	x	x
0	0	1	0	1	1	0	x	1	x	x	0
0	1	0	1	1	0	1	x	x	0	0	x
0	1	1	0	1	0	0	x	x	0	x	1
1	0	0	0	0	1	x	1	0	x	1	x
1	0	1	1	0	0	x	0	0	x	x	1
1	1	0	1	1	1	x	0	x	0	0	x
1	1	1	1	0	1	x	0	x	1	x	0

(J_a)

bc \ a	0	1
00	x	x
01		x
11		x
10	1	x

(J_b)

bc \ a	0	1
00	x	
01	1	
11	x	x
10	x	x

(J_c)

bc \ a	0	1
00	x	1
01	x	x
11	x	x
10		

(K_a)

bc \ a	0	1
00	x	1
01	x	
11	x	
10	x	

(K_b)

bc \ a	0	1
00	x	x
01	x	x
11		1
10		

(K_c)

bc \ a	0	1
00	x	x
01		1
11	1	
10	x	x

$J_a = c'$ $\quad J_b = a'$ $\quad J_c = b'$

$K_a = b'c'$ $\quad K_b = ac$ $\quad K_c = ab' + a'b$

$= (a+b)(a'+b')$

$= (a'b'ab)'$

$= 1$

If state is 000

$J_a = 1$ $\quad J_b = 1$ $\quad J_c = 1$

$K_a = 1$ $\quad K_b = 0$ $\quad K_c = 1$,

So, the next state will be 111

b) Use S-R flip-flops

a	b	c	d	e	f	S_a	R_a	S_b	R_b	S_c	R_c
0	0	0	x	x	x	x	x	x	x	x	x
0	0	1	0	1	1	0	x	1	0	x	0
0	1	0	1	1	0	1	0	x	0	0	x
0	1	1	0	1	0	0	x	x	0	0	1
1	0	0	0	0	1	0	1	0	x	1	0
1	0	1	1	0	0	x	0	0	x	0	1
1	1	0	1	1	1	x	0	x	0	1	0
1	1	1	1	0	1	x	0	0	1	x	0

(S_a)

bc \ a	0	1
00	X	
01		x
11		X
10	1	X

(S_b)

bc \ a	0	1
00	X	
01	1	
11	X	
10	X	X

(S_c)

bc \ a	0	1
00	X	1
01	X	
11		X
10		1

(R_a)

bc \ a	0	1
00	X	1
01	X	
11	X	
10		

(R_b)

bc \ a	0	1
00	X	X
01		X
11		1
10		

(R_c)

bc \ a	0	1
00	X	
01	X	1
11	1	
10		

$S_a = bc'$ $\quad S_b = a'$ $\quad S_c = ac'$

$R_a = b'c'$ $\quad R_b = ac$ $\quad R_c = b'c + a'c = c(a'+b')$

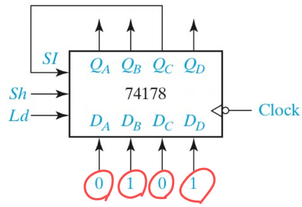
If state is 0 0 0

$S_a = 0$ $\quad S_b = 1$ $\quad S_c = 0$

$R_a = 1$ $\quad R_b = 0$ $\quad R_c = 0$

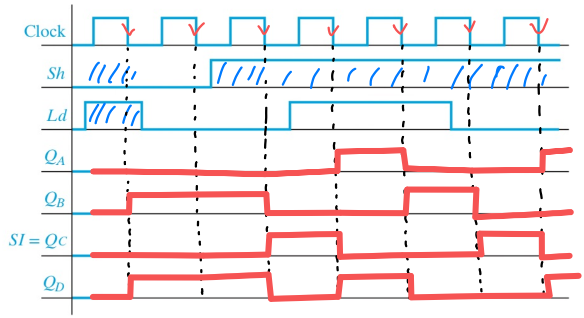
So, the next state will be 0 1 0

12.13>



Sh	Ld	Q_A^+	Q_B^+	Q_C^+	Q_D^+
0	0	Q_A	Q_B	Q_C	Q_D
0	1	D_A	D_B	D_C	D_D
1	X	SI	Q_A	Q_B	Q_C

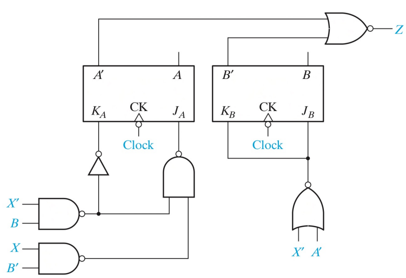
$SI = Q_C$



* All state changes occur on the 1→0 transition of the clock

→ falling edge triggered

13.3>



a) $J_A = ((x'B)'(xB')')' = x'B + xB' = X \oplus B$

$K_A = ((x'B)')' = x'B$

$J_B = (X'+A')' = XA$

$K_B = (X'+A')' = XA$

$Z = (A'+B')' = AB$ by applying $(Q^+ = JQ' + K'Q)$

$$A^+ = (x'B + xB')A' + (x'B)'A = A'Bx' + A'B'x + (x+B')A$$

$$= A'Bx' + A'B'x + Ax + AB' = A'Bx' + AB' + x(A + A'B')$$

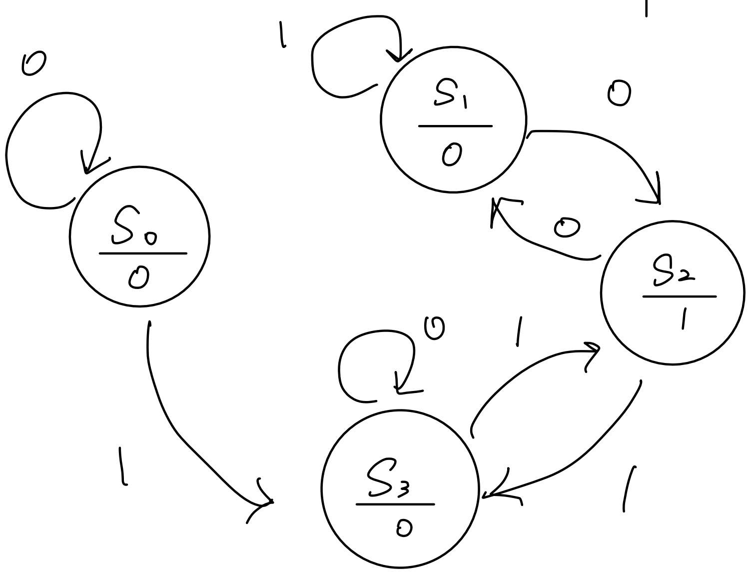
$$= A'Bx' + AB' + x(A + B') = A'Bx' + AB' + Ax + B'x$$

$$B^+ = xAB' + (xA)'B = AB'x + (x' + A')B = AB'x + A'B + Bx'$$

	AB	A^+B^+ $x=0$	A^+B^+ $x=1$	Z
(S_0)	0 0	0 0	1 0	0
(S_1)	0 1	1 1	0 1	0
(S_2)	1 1	0 1	1 0	1
(S_3)	1 0	1 0	1 1	0

↓

present state	next state $x=0$	next state $x=1$	present output
S_0	S_0	S_3	0
S_1	S_2	S_1	0
S_2	S_1	S_3	1
S_3	S_3	S_2	0



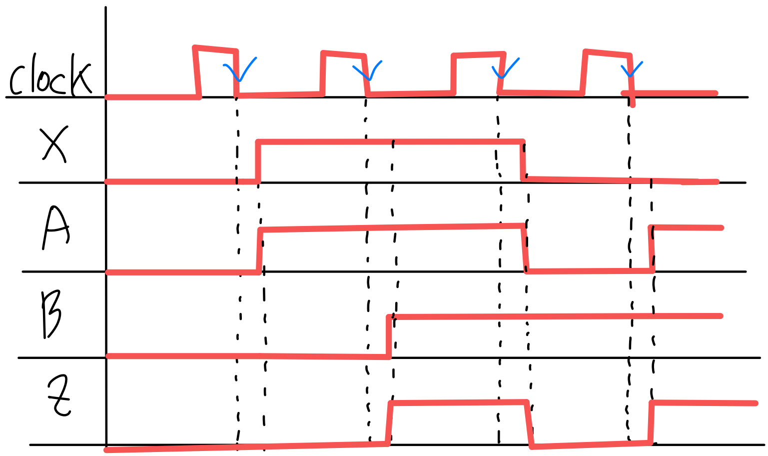
This is a Moore machine.

b) input sequence is $X = 01100$

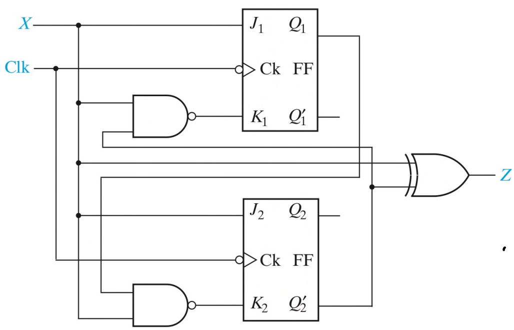
By referring to a graph in (a)

output sequence is 00100

c) input changed between falling and rising clock edges



13.17) a)



$J_1 = x$

$K_1 = (xQ_2')'$ $\qquad Z = x \oplus Q_2'$

$J_2 = X$

$K_2 = (Q \cdot X)'$

By applying $(Q^+ = JQ' + K'Q)$

$$Q_1^+ = XQ_1' + ((XQ_2')')'Q_1 = XQ_1' + XQ_2'Q_1$$

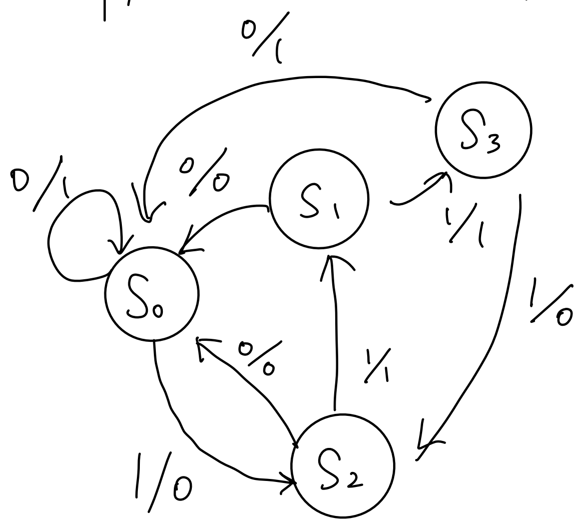
$$Q_2^+ = XQ_2' + ((Q_1X)')'Q_2 = XQ_2' + Q_1XQ_2$$

$$Z = X \oplus Q_2' = X'Q_2' + XQ_2$$

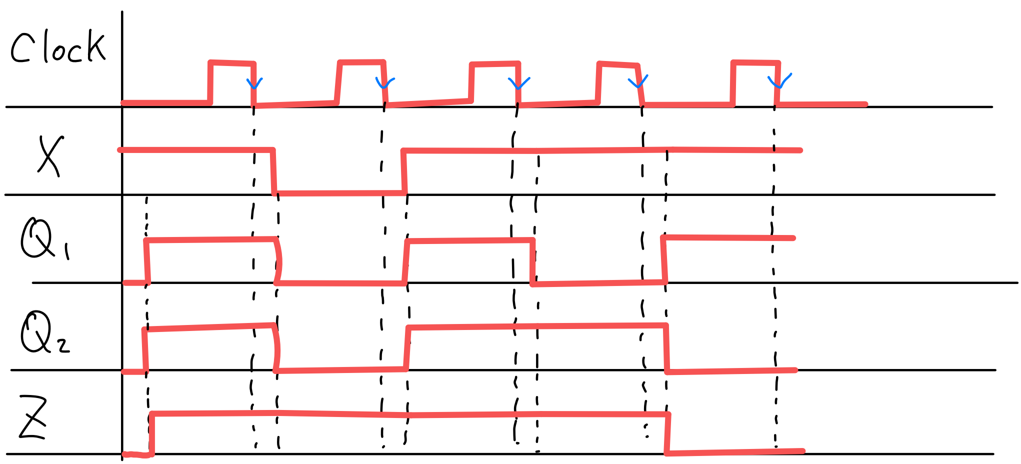
Q_1Q_2	$Q_1^+Q_2^+$ $X=0$	$X=1$	Z $X=0$	$X=1$
0 0	0 0	1 1	1	0
0 1	0 0	1 0	0	1
1 1	0 0	0 1	0	1
1 0	0 0	1 1	1	0

→

present state	Next state $X=0$	$X=1$	present output $X=0$	$X=1$
S_0	S_0	S_2	1	0
S_1	S_0	S_3	0	1
S_2	S_0	S_1	0	1
S_3	S_0	S_2	1	0



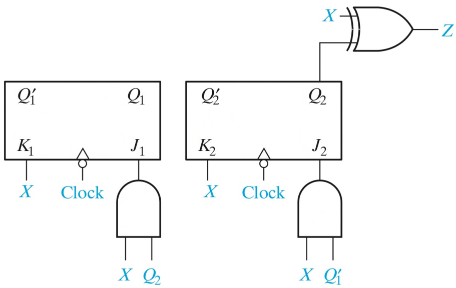
b)



c) output values is 1 1 1 1 0

when checking only the values just before falling edges

13.11) a)



$J_1 = XQ_2$

$K_1 = X$

$J_2 = XQ_1'$

$K_2 = X$

$Z = X \oplus Q_2$

By applying ($Q^+ = JQ' + K'Q$)

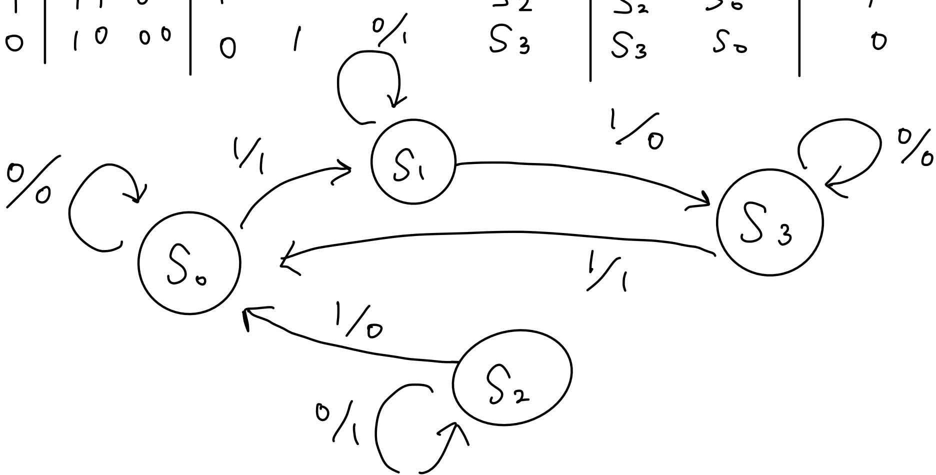
$Q_1^+ = (XQ_2)Q_1' + X'Q_1 = XQ_1'Q_2 + X'Q_1$

$Q_2^+ = (XQ_1')Q_2' + X'Q_2 = XQ_1'Q_2' + X'Q_2$ $\quad Z = X'Q_2 + XQ_2'$

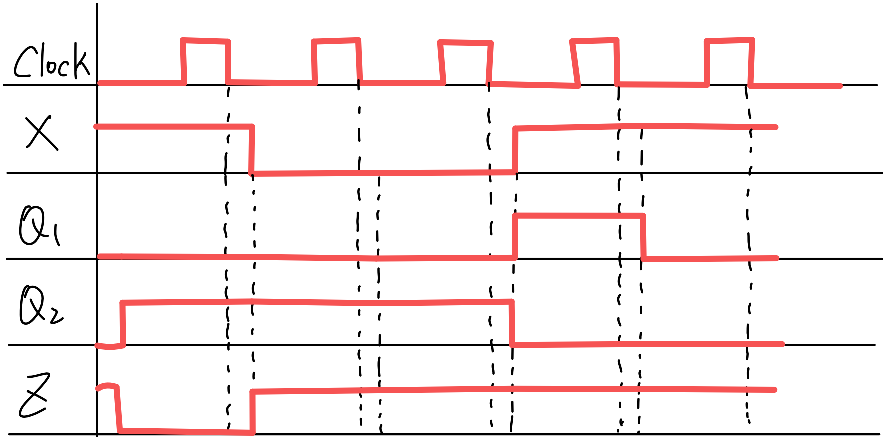
Q_1Q_2	$Q_1^+Q_2^+$ $X=0$	$X=1$	Z $X=0$	$X=1$
0 0	0 0	0 1	0	1
0 1	0 1	1 0	1	0
1 1	1 1	0 0	1	0
1 0	1 0	0 0	0	1

$\rightarrow$

present state	next state $X=0$	$X=1$	present output $X=0$	$X=1$
S_0	S_0	S_1	0	1
S_1	S_1	S_3	1	0
S_2	S_2	S_0	1	0
S_3	S_3	S_0	0	1



b)



correct output value is 0 1 1 1 1

when checking only the values just before falling edges