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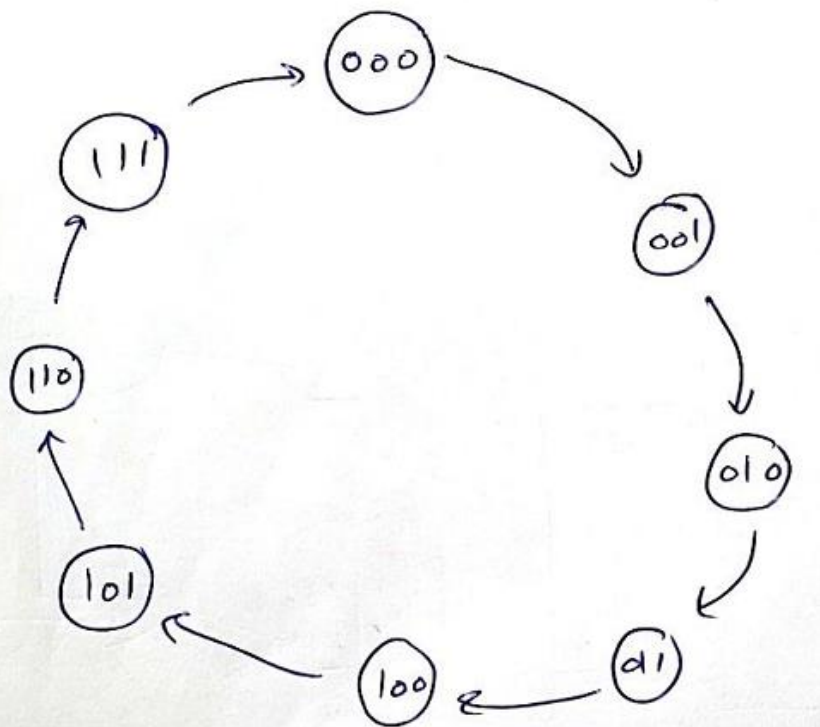
Tulkaram, Palestine

Design of Synchronous Counter.

example :- Design synchronous counter that count from (0 \rightarrow 7). using JK flip flops

* Step 1 State diagram

* $2^3 = 8$ level.



* JK truth table. (excitation)

Q	Q ⁺	J	K
0	0	0	X
1	0	X	1
0	1	1	X
1	1	X	0

* Step ② + Step ③ Next state table + Transition table

Present state.			Next state.			J_2, K_2		J_1, K_1		J_0, K_0	
Q_2	Q_1	Q_0	Q_2^+	Q_1^+	Q_0^+						
0	0	0	0	0	1	0	X	0	X	1	X
0	0	1	0	1	0	0	X	1	X	X	1
0	1	0	0	1	1	0	X	X	0	1	X
0	1	1	1	0	0	1	X	X	1	X	1
1	0	0	1	0	1	X	0	0	X	1	X
1	0	1	1	1	0	X	0	1	X	X	1
1	1	0	1	1	1	X	0	X	0	1	X
1	1	1	0	0	0	X	1	X	1	X	1

* J-K truth table. (excitation)

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

* Step 4) Karnaugh maps.

Q_2	Q_1	Q_0	00	01	11	10
0					1	
1	X	X	X	X		

$\bar{J}_2 = Q_1 Q_0$

Q_2	Q_1	Q_0	00	01	11	10
0				1	X	X
1				1	X	X

$\bar{J}_1 = Q_0$

Q_2	Q_1	Q_0	00	01	11	10
0			1	X	X	1
1			1	X	X	1

$\bar{J}_a = 1$

Q_2	Q_1	Q_0	00	01	11	10
0	X	X	X	X		
1					1	

$K_2 = Q_1 Q_0$

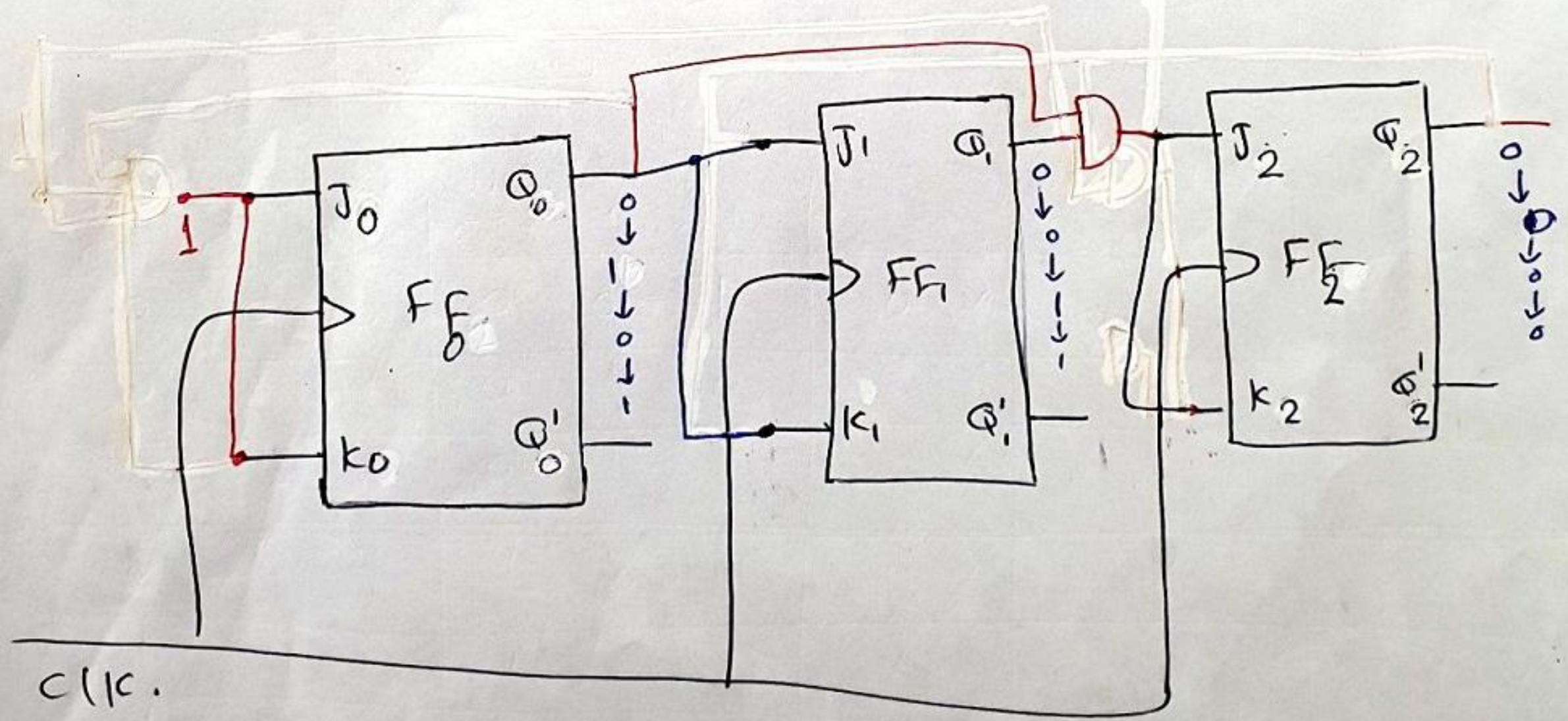
Q_2	Q_1	Q_0	00	01	11	10
0	X		X	1		
1			X	1		

$K_1 = Q_0$

Q_2	Q_1	Q_0	00	01	11	10
0	X		1	1		X
1	X		1	1		X

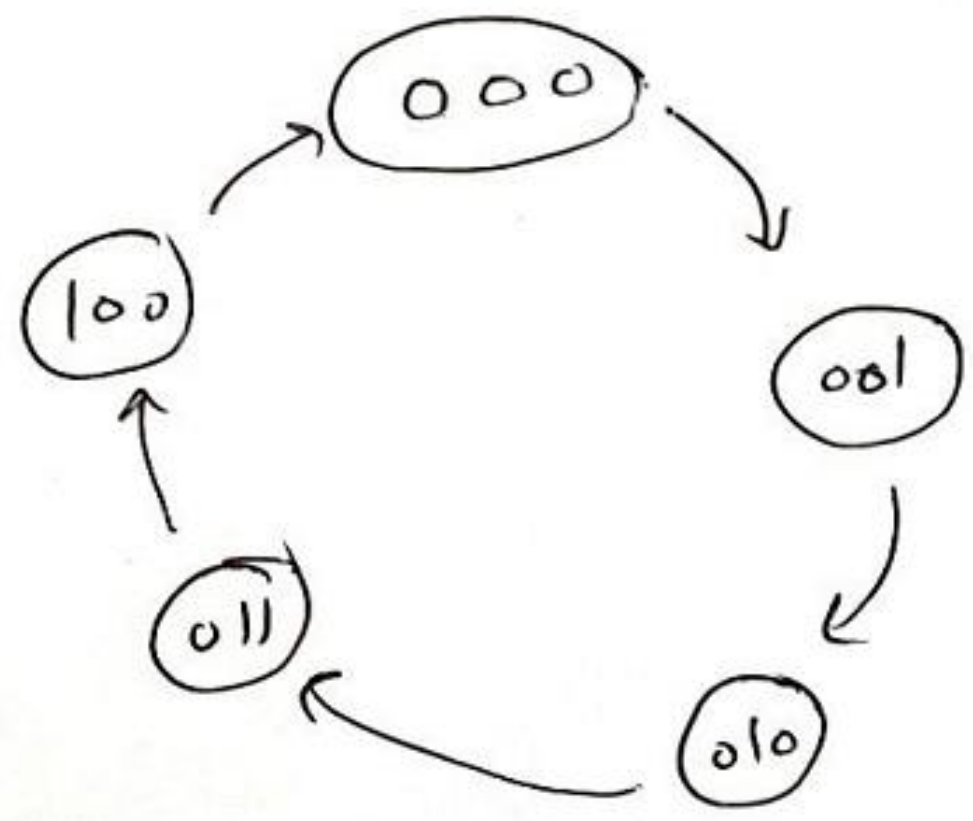
$K_a = 1$

* Step ⑤ Counter Implementation.



example :- Designe counter that count from 0 \rightarrow 4

Step ①



Q	Q ⁺	J	K
0	0	0	X
1	0	X	1
0	1	1	X
1	1	X	0

Step ② + step ③

Q_2	Q_1	Q_0	Q_2^+	Q_1^+	Q_0^+	J_2	k_2	J_1, k_1	J_0, k_0
0	0	0	0	0	1	0	X	0 X	1 X
0	0	1	0	1	0	0	X	1 X	X 1
0	1	0	0	1	1	0	X	X 0	1 X
0	1	1	1	0	0	1	X	X 1	X 1
1	0	0	0	0	0	X	1	0 X	0 X
1	0	1	X	X	X	X	X	X X	X X
1	1	0	X	X	X	X	X	X X	X X
1	1	1	X	X	X	X	X	X X	X X

* J, k truth table.
(excitation)

Q	Q^+	J	k
0	0	0	X
1	0	X	1
0	1	1	X
1	1	X	0

$\Phi_2 \backslash \Phi_1 \Phi_0$

	00	01	11	10
0	0	0	1	0
1	X	X	X	X

$$J_2 = \Phi_1 \Phi_0$$

$\Phi_2 \backslash \Phi_1 \Phi_0$

	00	01	11	10
0	0	1	X	X
1	0	X	X	X

$$J_1 = \Phi_0$$

$\Phi_2 \backslash \Phi_1 \Phi_0$

	00	01	11	10
0	1	X	X	1
1	0	X	X	X

$$\bar{J}_0 = \Phi_2^1$$

$\Phi_2 \backslash \Phi_1 \Phi_0$

	00	01	11	10
0	X	X	X	X
1	1	X	X	X

$$K_2 = 1$$

$\Phi_2 \backslash \Phi_1 \Phi_0$

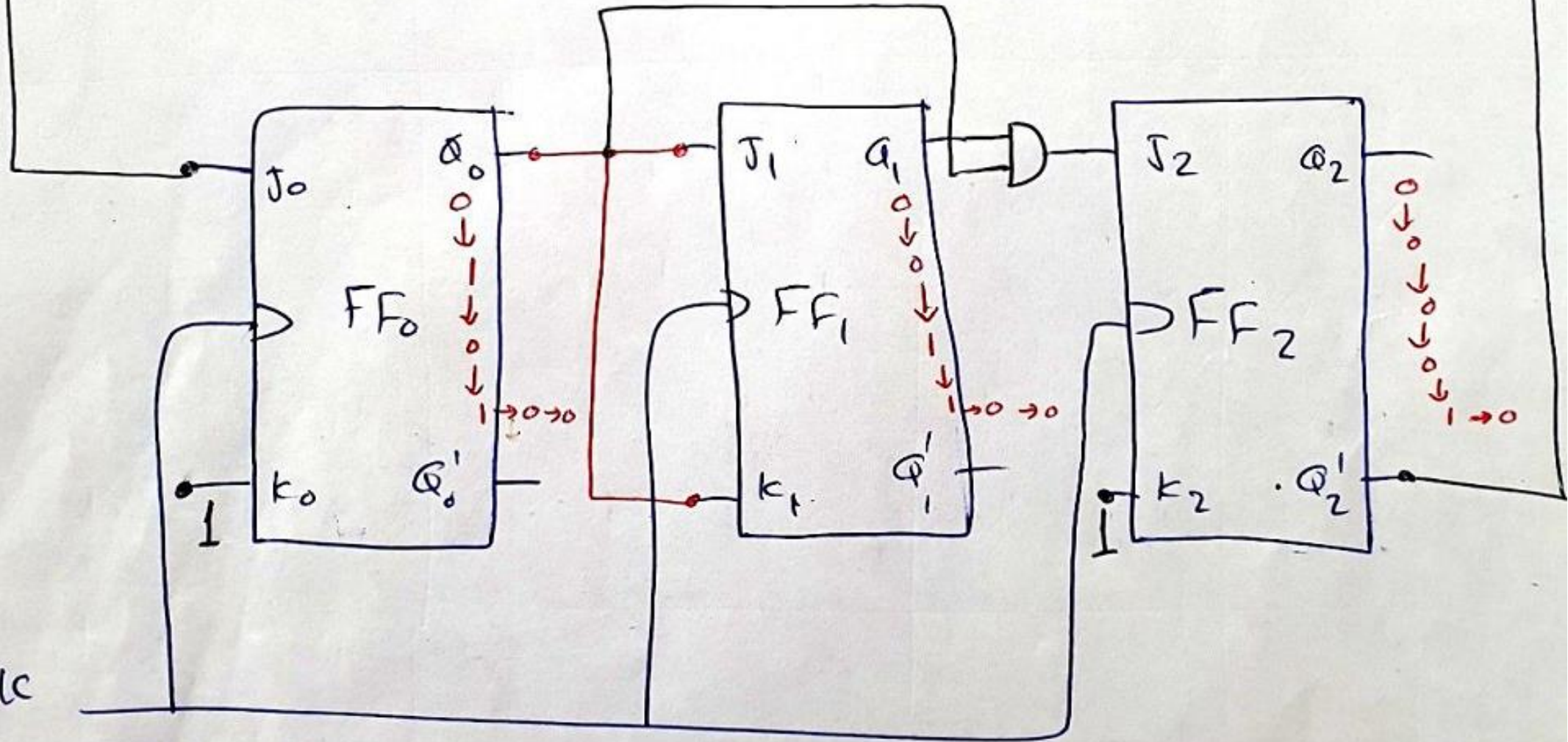
	00	01	11	10
0	X	X	1	0
1	X	X	X	X

$$K_1 = \Phi_0$$

$\Phi_2 \backslash \Phi_1 \Phi_0$

	00	01	11	10
0	X	1	1	X
1	X	X	X	X

$$K_0 = 1$$



example:-

Design a counter with the following repeated binary sequence :- 0, 2, 4, 6 using JK flip flop (even number)

Present state			Next state:			FF ₂		FF ₁		FF ₀	
Q ₂	Q ₁	Q ₀	Q ₂ ⁺	Q ₁ ⁺	Q ₀ ⁺	J ₂	K ₂	J ₁	K ₁	J ₀	K ₀
0	0	0	0	1	0	0	X	1	X	0	X
0	0	1	X	X	X	X	X	X	X	X	X
0	1	0	1	0	0	1	X	X	1	0	X
0	1	1	X	X	X	X	X	X	X	X	X
1	0	0	1	1	0	X	0	1	X	0	X
1	0	1	X	X	X	X	X	X	X	X	X
1	1	0	0	0	0	X	1	X	1	0	X
1	1	1	X	X	X	X	X	X	X	X	X

* JK truth table (excitation)

Q	Q ⁺	J	K
0	0	0	X
1	0	X	1
0	1	1	X
1	1	X	0

Q_1, Q_0

Q_2	00	01	11	10
0	0	X	X	1
1	X	X	X	X

$J_2 = Q_1$

Q_1, Q_0

Q_2	00	01	11	10
0	X	X	X	X
1	0	X	X	1

$K_2 = Q_1$

Q_1, Q_0

Q_2	00	01	11	10
0	1	X	X	X
1	1	X	X	X

$J_1 = 1$

Q_1, Q_0

Q_2	00	01	11	10
0	X	X	X	1
1	X	X	X	1

$K_1 = 1$

Q_1, Q_0

Q_2	00	01	11	10
0	0	X	X	0
1	0	X	X	0

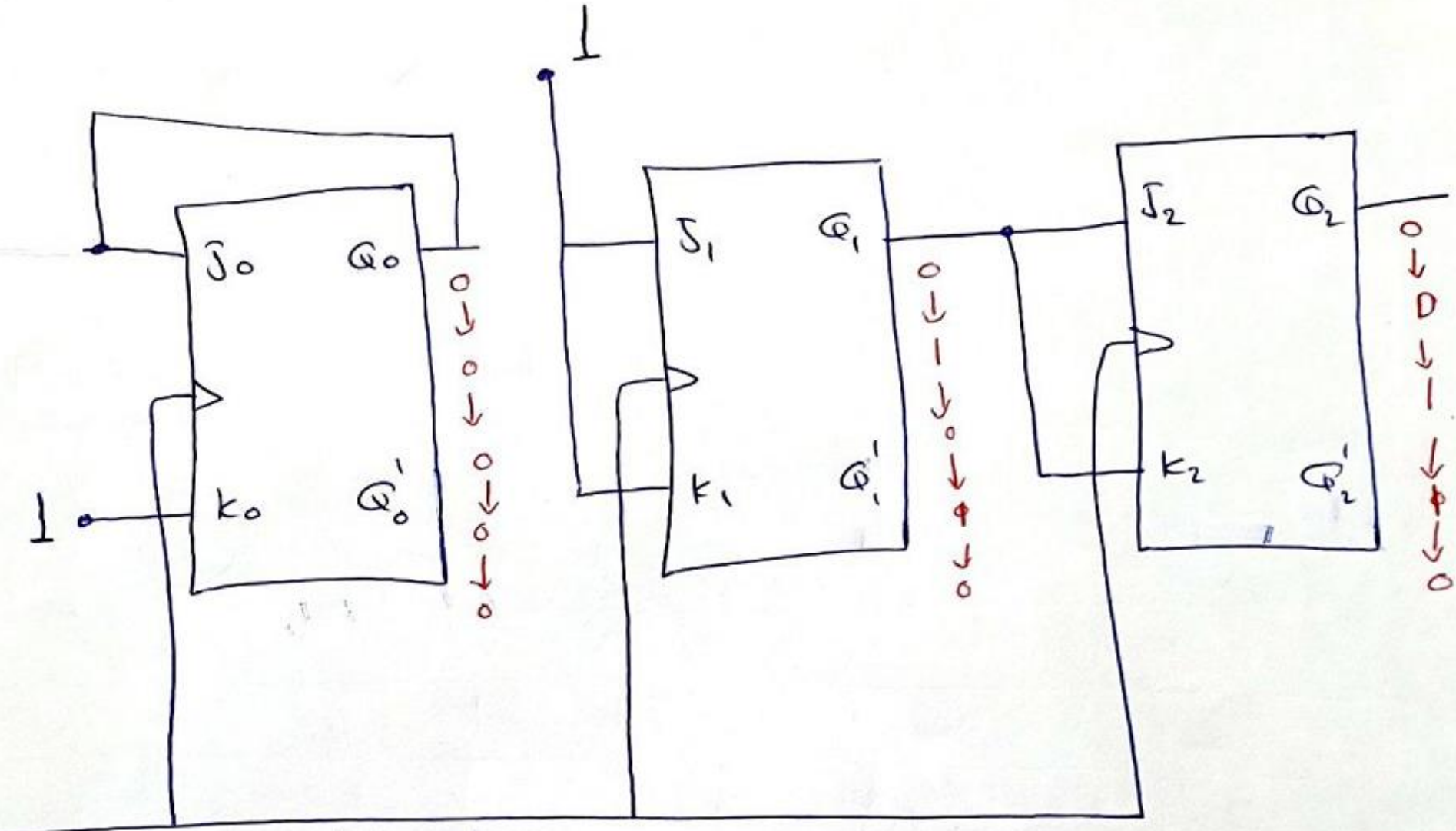
$J_0 = Q_0$

Q_1, Q_0

Q_2	00	01	11	10
0	X	X	X	X
1	X	X	X	X

$K_0 = 1$

Clk.



Thank You