Clase 7

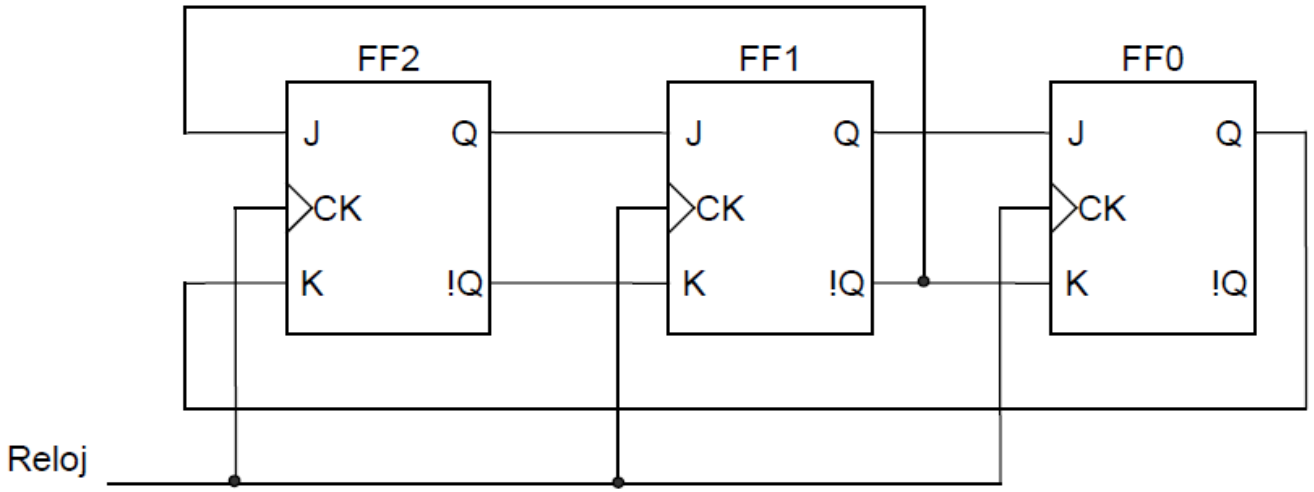
Práctico de Diseño Lógico

Clase 7 – temas

- Contadores
  - Autoarranque
- Modo Reloj
  - Diagrama de estados.
  - Tabla de estados.
  - Minimización de estados.
  - Circuito.
  - Diagrama de tiempos.

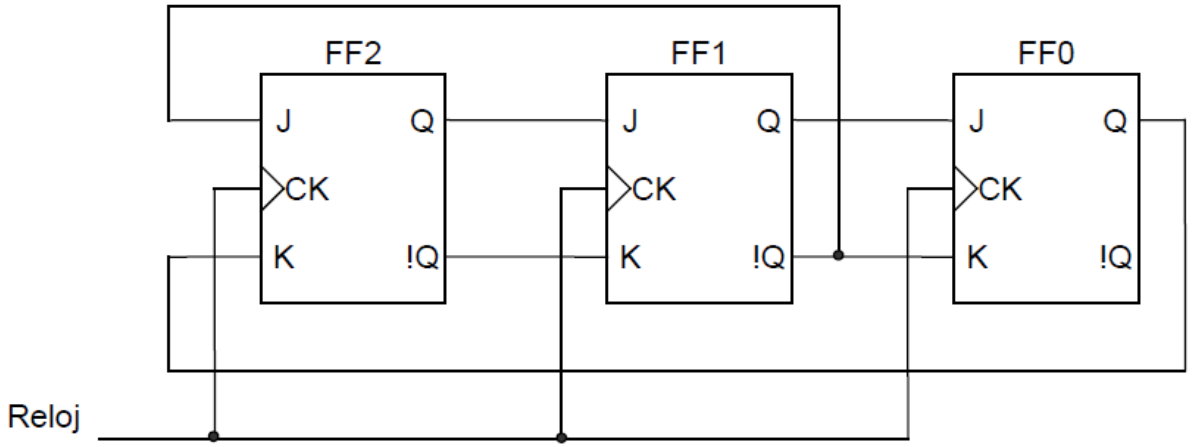
Contadores - Ejercicio 7.1

Ejercicio 1. (Millman 7-17)
a) Supóngase que en el contador de anillo modificado de la figura se tiene inicialmente Q0=Q1=0 y Q2=1. Hágase una tabla de las lecturas de Q0,Q1,Q2,J2 y K2 después de cada impulso del reloj. ¿Cuántos impulsos se necesitan antes de que el sistema empiece a funcionar como contador divisor por N?. ¿Qué es N ?



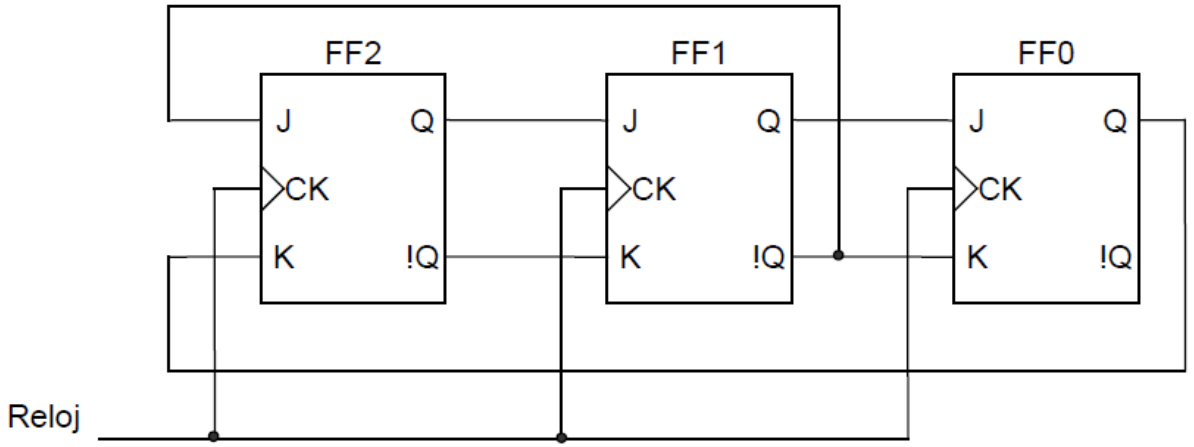
b) Repetir la parte a) si inicialmente Q0=Q2=0, Q1=1.

CONTADOR:
1) no tiene entradas



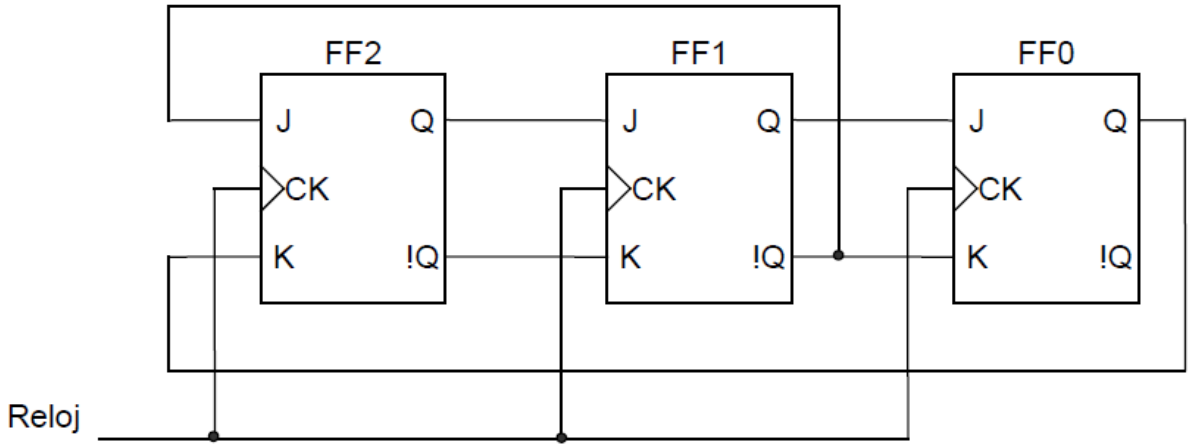
clk	J	K	Q	/Q
↗	0	0	Q	/Q
↗	0	1	0	1
↗	1	0	1	0
↗	1	1	/Q	Q
0	X	X	Q	/Q
1	X	X	Q	/Q

Q2	Q1	Q0	J2	K2	J1	K1	J0	K0
1	0	0						



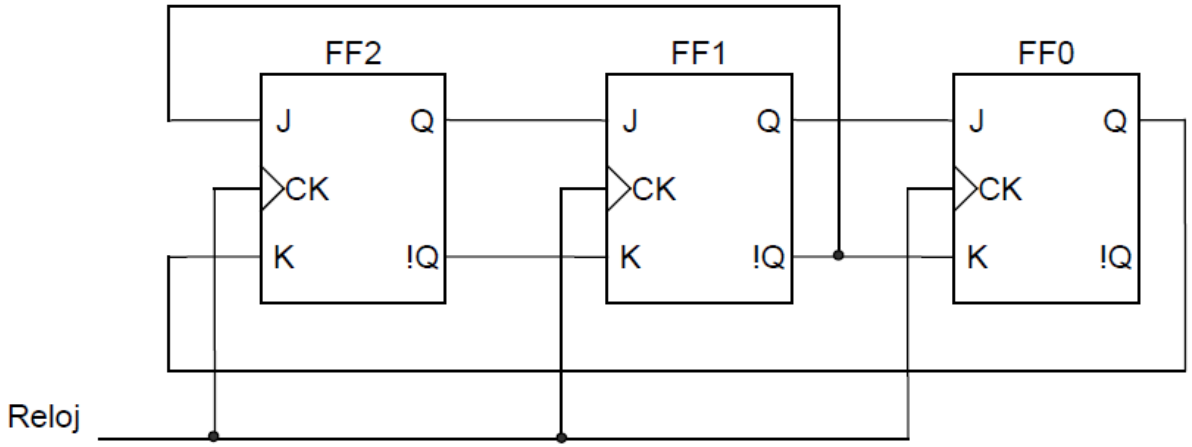
clk	J	K	Q	/Q
↗	0	0	Q	/Q
↗	0	1	0	1
↗	1	0	1	0
↗	1	1	/Q	Q
0	X	X	Q	/Q
1	X	X	Q	/Q

			!Q1	Q0	Q2	!Q2	Q1	!Q1
Q2	**Q1**	**Q0**	**J2**	**K2**	**J1**	**K1**	**J0**	**K0**
1	0	0						



clk	J	K	Q	/Q
↗	0	0	Q	/Q
↗	0	1	0	1
↗	1	0	1	0
↗	1	1	/Q	Q
0	X	X	Q	/Q
1	X	X	Q	/Q

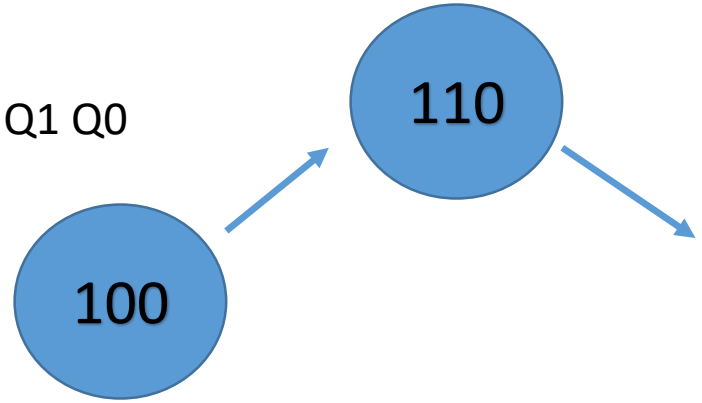
			!Q1	Q0	Q2	!Q2	Q1	!Q1
Q2	**Q1**	**Q0**	**J2**	**K2**	**J1**	**K1**	**J0**	**K0**
1	0	0	1	0	1	0	0	1

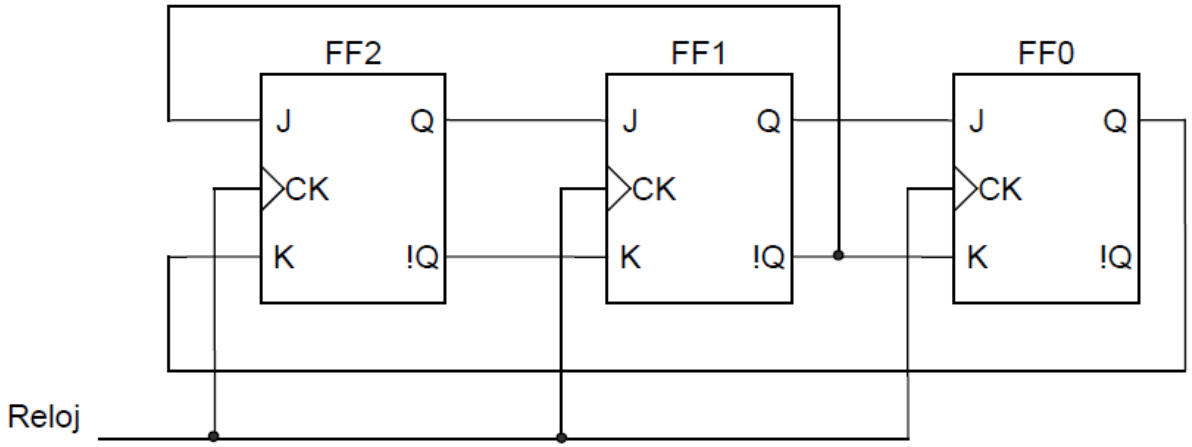


clk	J	K	Q	/Q
↗	0	0	Q	/Q
↗	0	1	0	1
↗	1	0	1	0
↗	1	1	/Q	Q
0	X	X	Q	/Q
1	X	X	Q	/Q

			!Q1	Q0	Q2	!Q2	Q1	!Q1
Q2	**Q1**	**Q0**	**J2**	**K2**	**J1**	**K1**	**J0**	**K0**
1	0	0	1	0	1	0	0	1
1	1	0						

Q2 Q1 Q0

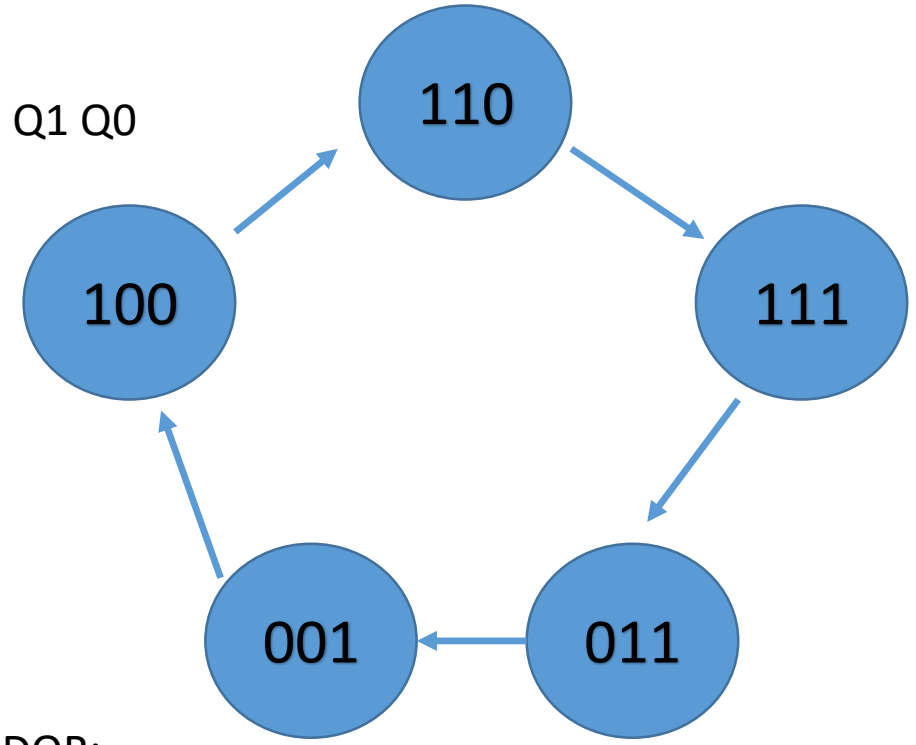




clk	J	K	Q	/Q
↗	0	0	Q	/Q
↗	0	1	0	1
↗	1	0	1	0
↗	1	1	/Q	Q
0	X	X	Q	/Q
1	X	X	Q	/Q

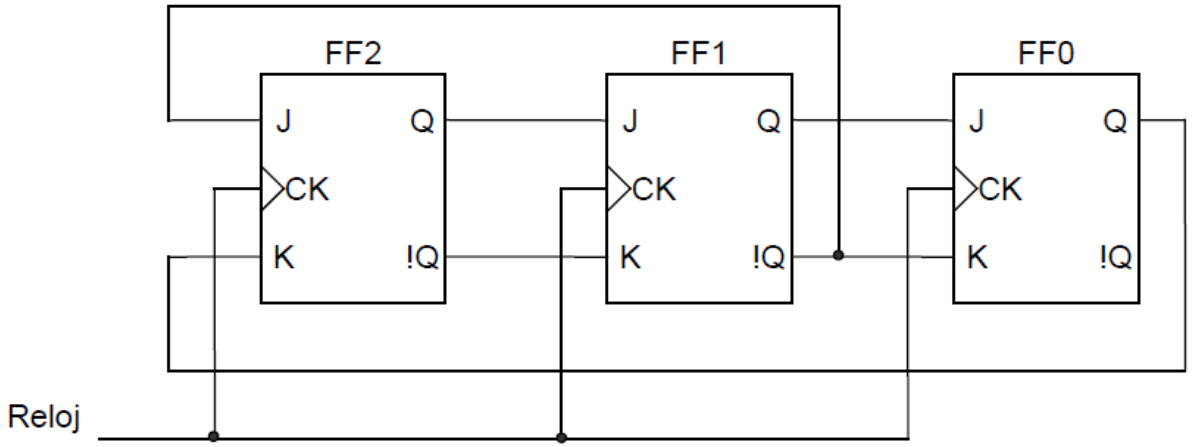
			!Q1	Q0	Q2	!Q2	Q1	!Q1
Q2	**Q1**	**Q0**	**J2**	**K2**	**J1**	**K1**	**J0**	**K0**
1	0	0	1	0	1	0	0	1
1	1	0	0	0	1	0	1	0
1	1	1	0	1	1	0	1	0
0	1	1	0	1	0	1	1	0
0	0	1	1	1	0	1	0	1
1	0	0						

Q2 Q1 Q0



CONTADOR:

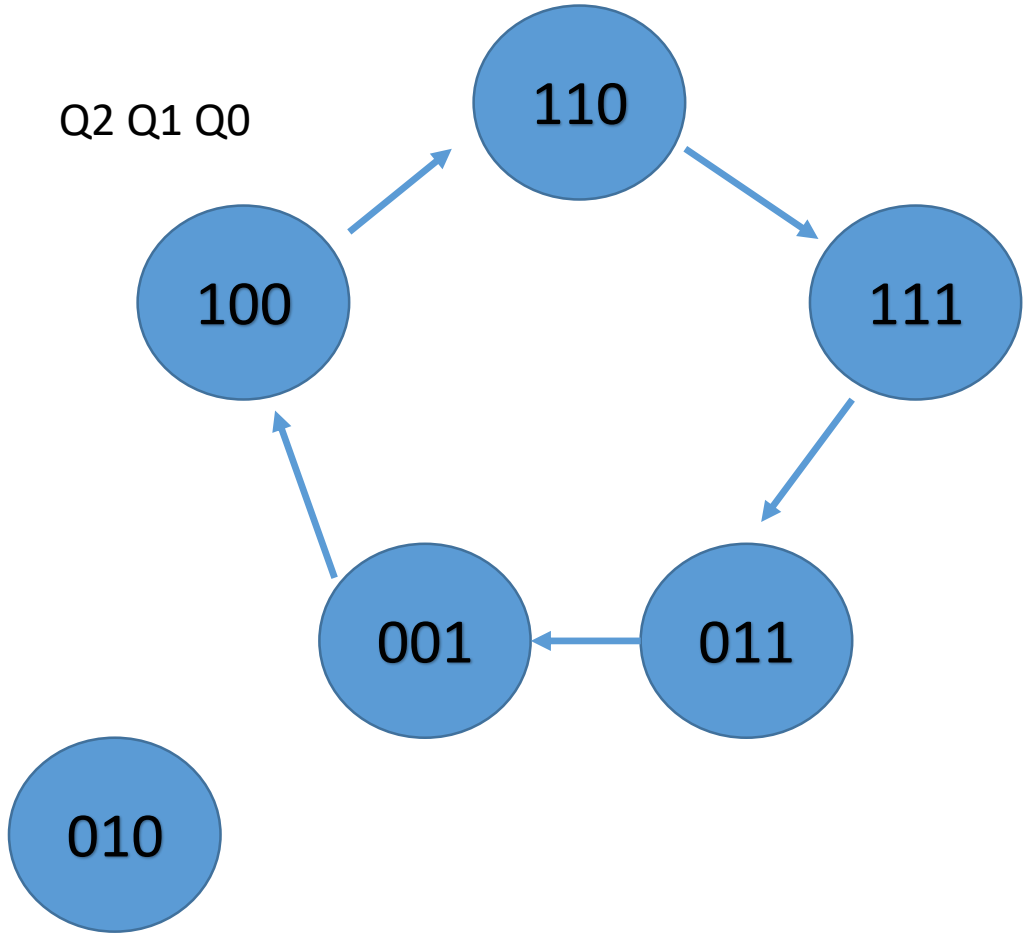
2) se ve en el diagrama de estados que su comportamiento es periódico.

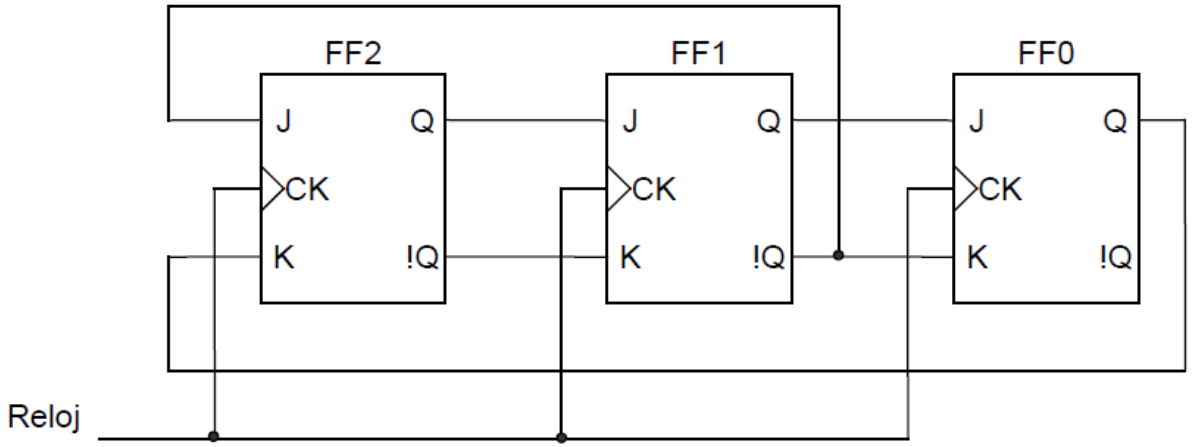


clk	J	K	Q	/Q
↗	0	0	Q	/Q
↗	0	1	0	1
↗	1	0	1	0
↗	1	1	/Q	Q
0	X	X	Q	/Q
1	X	X	Q	/Q

			!Q1	Q0	Q2	!Q2	Q1	!Q1
Q2	**Q1**	**Q0**	**J2**	**K2**	**J1**	**K1**	**J0**	**K0**
0	1	0						

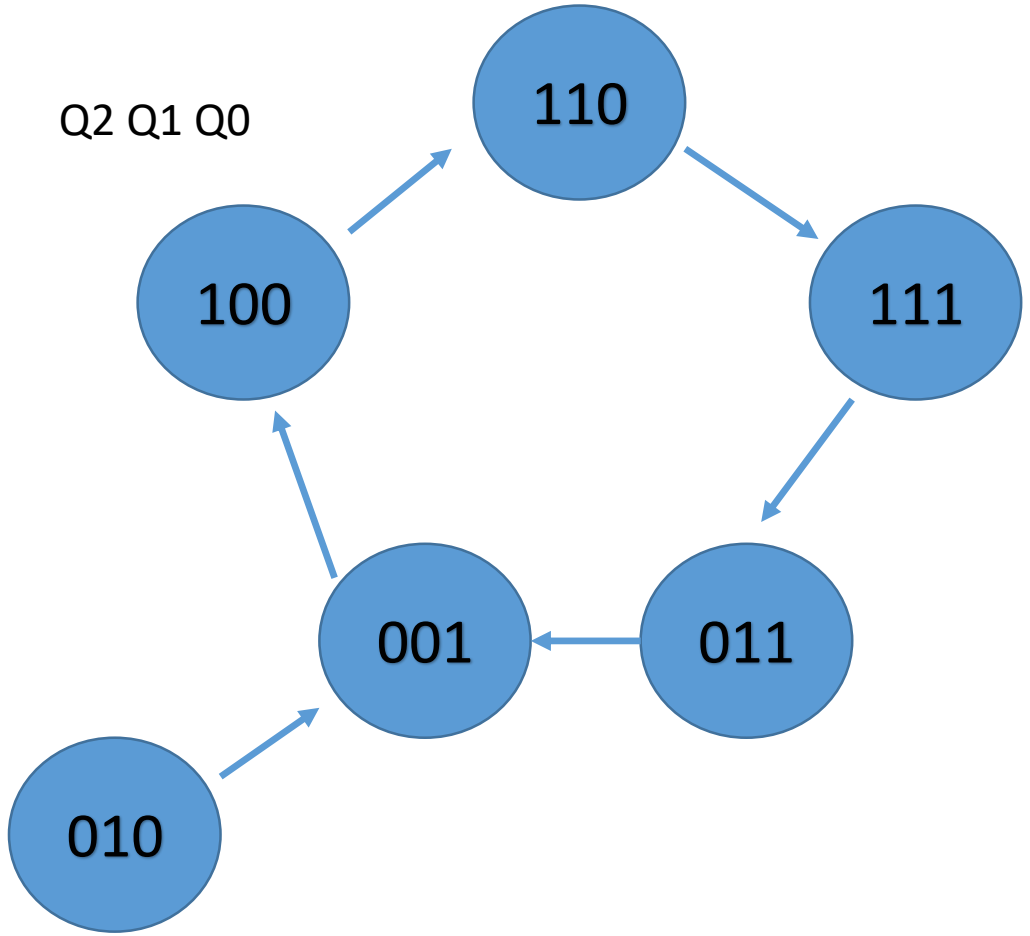
Q2 Q1 Q0

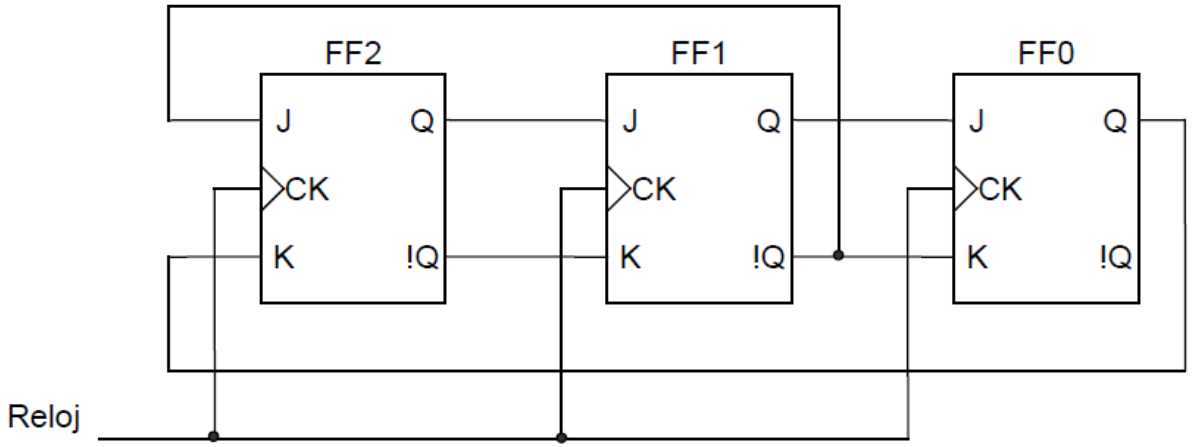




clk	J	K	Q	/Q
↗	0	0	Q	/Q
↗	0	1	0	1
↗	1	0	1	0
↗	1	1	/Q	Q
0	X	X	Q	/Q
1	X	X	Q	/Q

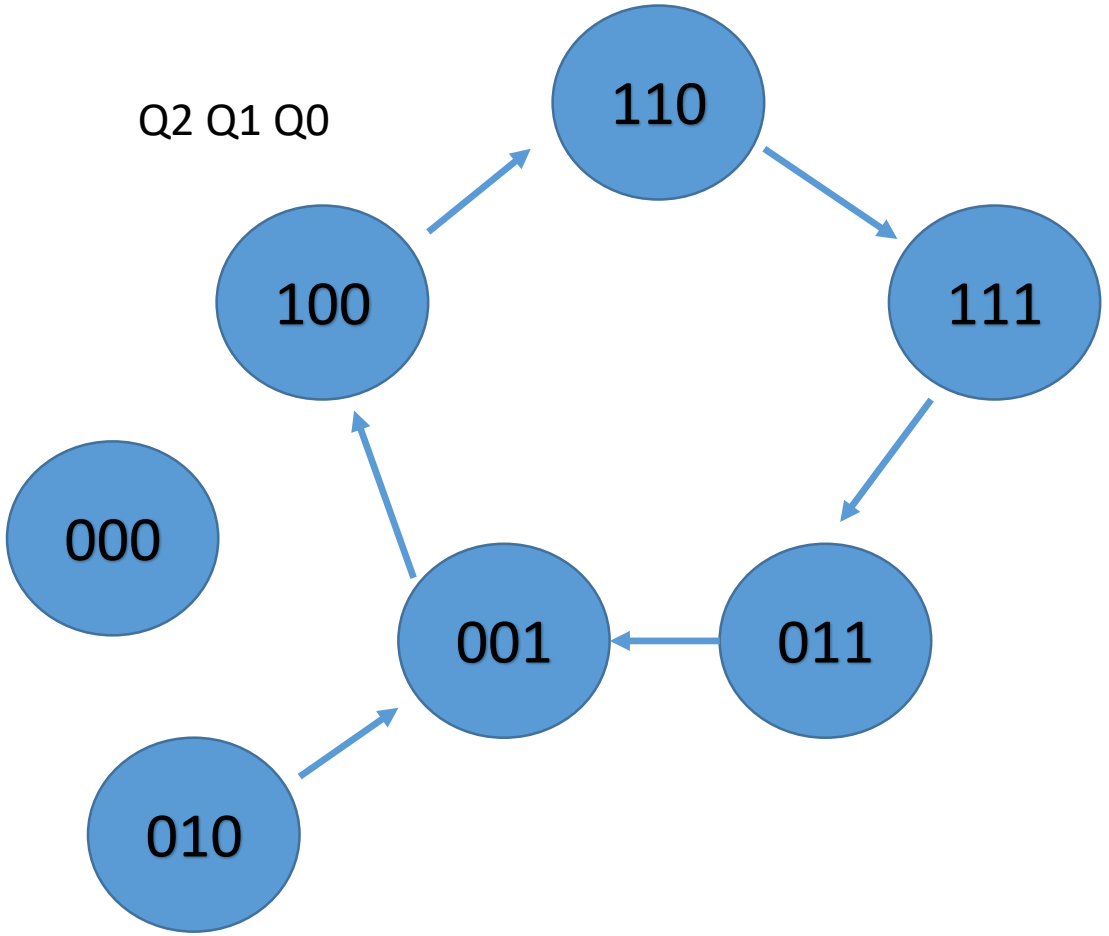
			!Q1	Q0	Q2	!Q2	Q1	!Q1
Q2	**Q1**	**Q0**	**J2**	**K2**	**J1**	**K1**	**J0**	**K0**
0	1	0	0	0	0	1	1	0
0	0	1						

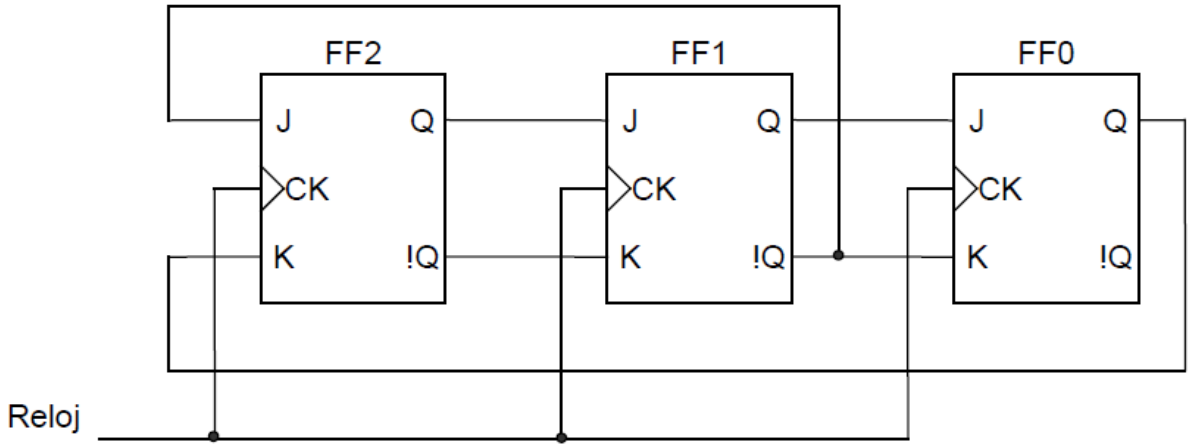




clk	J	K	Q	/Q
↗	0	0	Q	/Q
↗	0	1	0	1
↗	1	0	1	0
↗	1	1	/Q	Q
0	X	X	Q	/Q
1	X	X	Q	/Q

			!Q1	Q0	Q2	!Q2	Q1	!Q1
Q2	**Q1**	**Q0**	**J2**	**K2**	**J1**	**K1**	**J0**	**K0**
0	1	0	0	0	0	1	1	0
0	0	1						
0	0	0						





clk	J	K	Q	/Q
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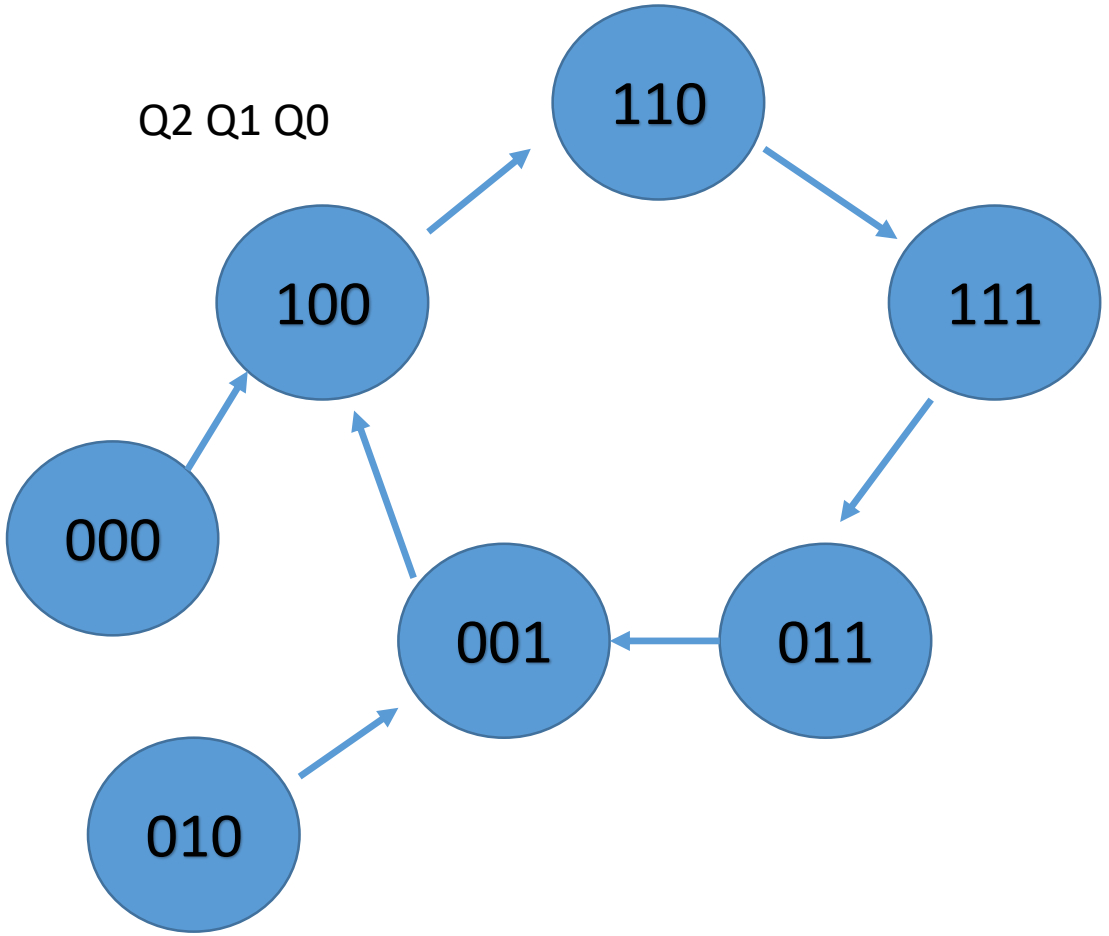
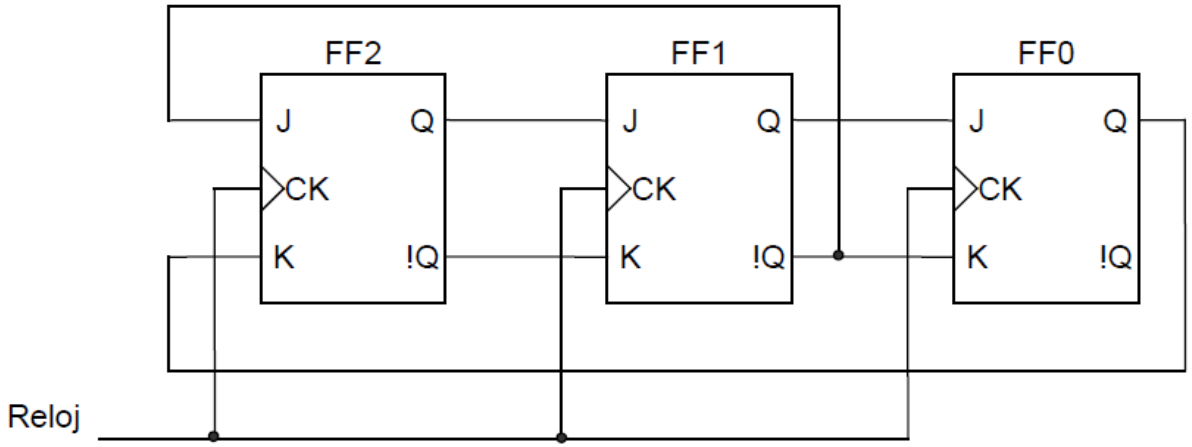
↗	0	1	0	1
↗	1	0	1	0
↗	1	1	/Q	Q
0	X	X	Q	/Q
1	X	X	Q	/Q

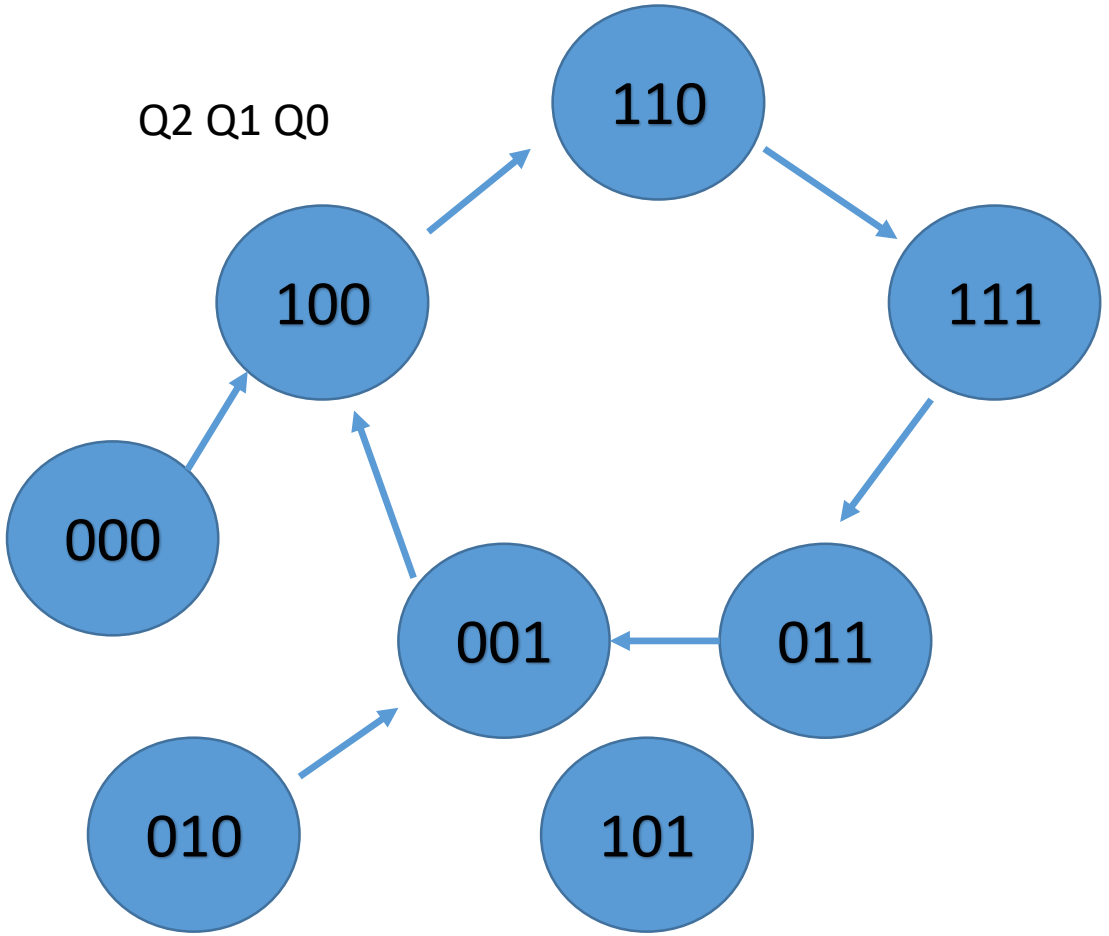
			!Q1	Q0	Q2	!Q2	Q1	!Q1
Q2	**Q1**	**Q0**	**J2**	**K2**	**J1**	**K1**	**J0**	**K0**
0	1	0	0	0	0	1	1	0
0	0	1						
0	0	0	1	0	0	1	0	1
1	0	0						

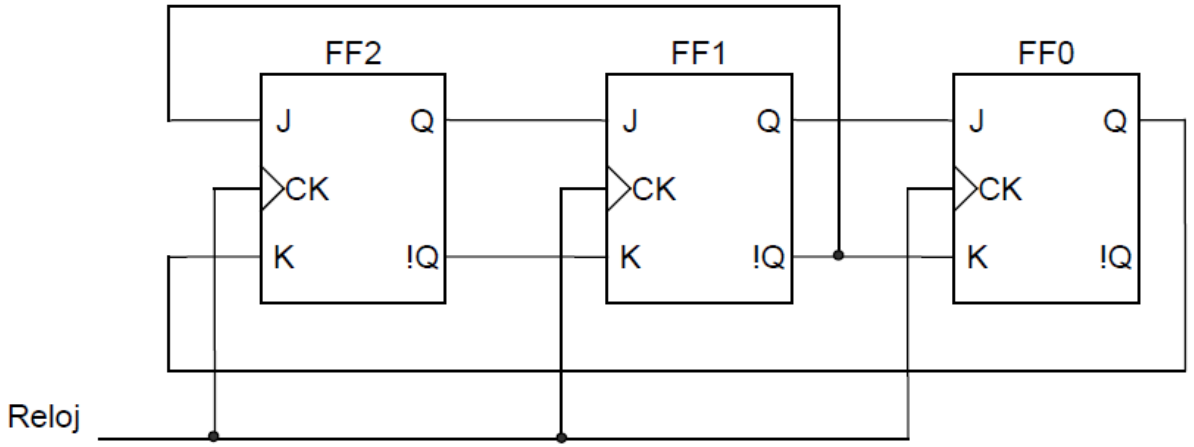




clk	J	K	Q	/Q
↗	0	0	Q	/Q
↗	0	1	0	1
↗	1	0	1	0
↗	1	1	/Q	Q
0	X	X	Q	/Q
1	X	X	Q	/Q

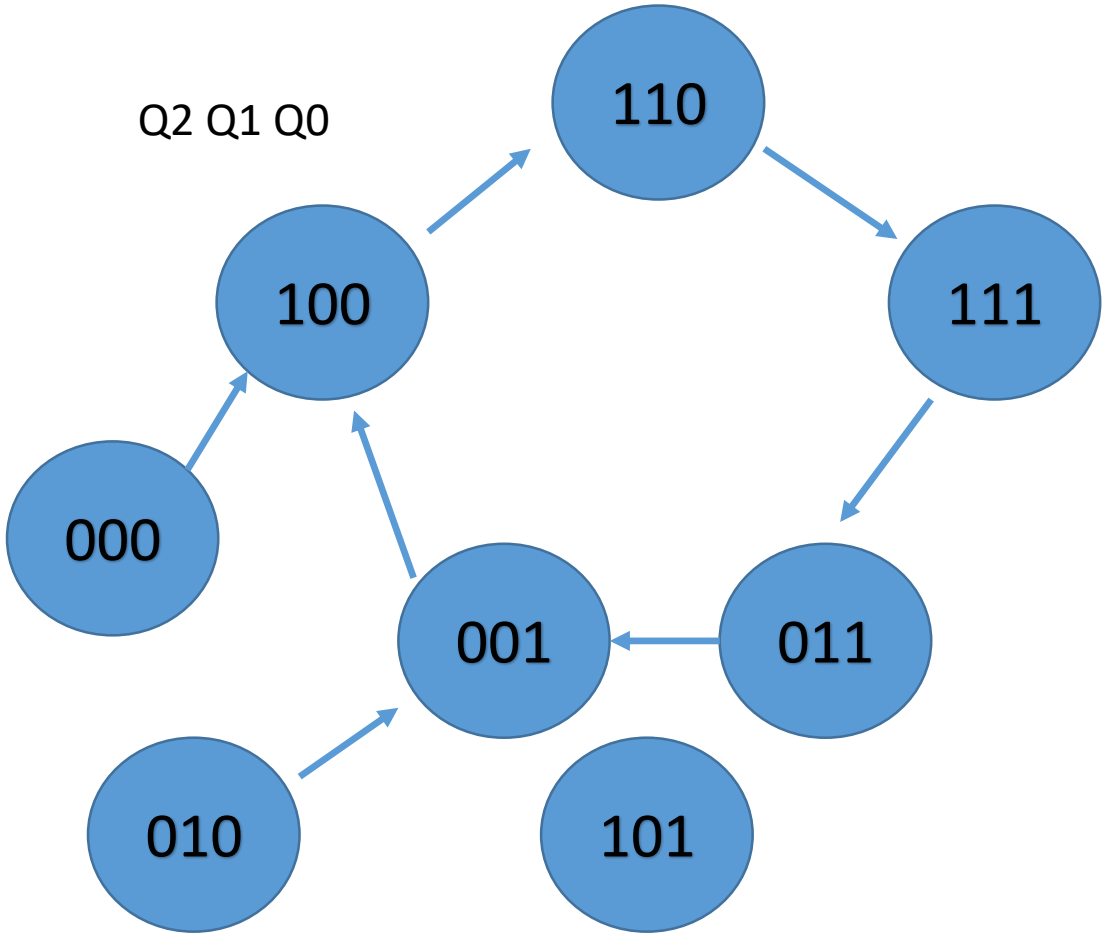
			!Q1	Q0	Q2	!Q2	Q1	!Q1
Q2	**Q1**	**Q0**	**J2**	**K2**	**J1**	**K1**	**J0**	**K0**
0	1	0	0	0	0	1	1	0
0	0	1						
0	0	0	1	0	0	1	0	1
1	0	0						
1	0	1						

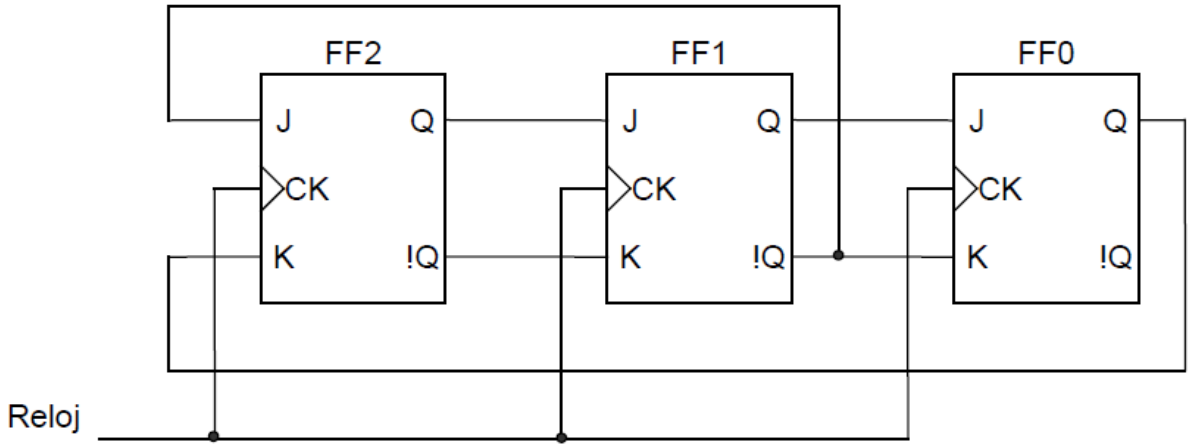




clk	J	K	Q	/Q
↗	0	0	Q	/Q
↗	0	1	0	1
↗	1	0	1	0
↗	1	1	/Q	Q
0	X	X	Q	/Q
1	X	X	Q	/Q

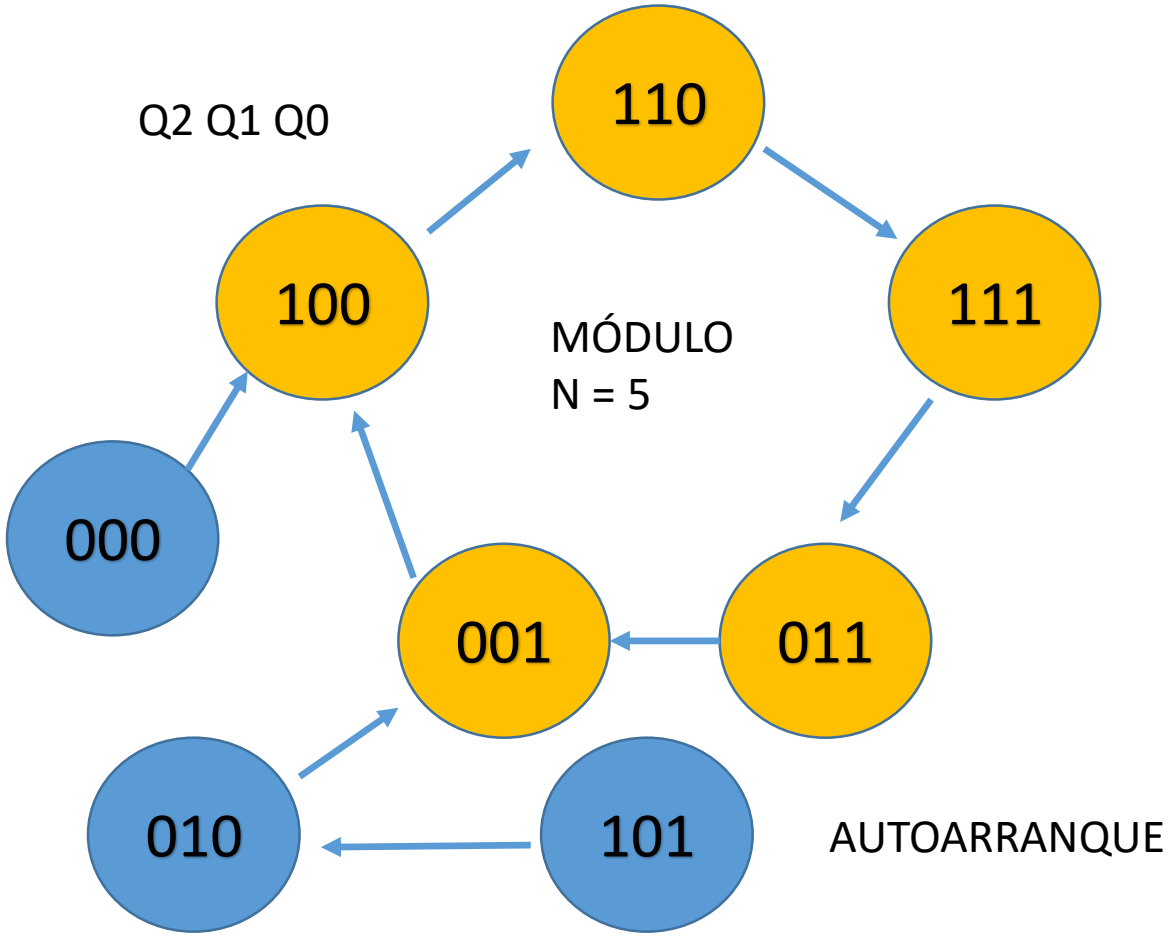
			!Q1	Q0	Q2	!Q2	Q1	!Q1
Q2	**Q1**	**Q0**	**J2**	**K2**	**J1**	**K1**	**J0**	**K0**
0	1	0	0	0	0	1	1	0
0	0	1						
0	0	0	1	0	0	1	0	1
1	0	0						
1	0	1	1	1	1	0	0	1





clk	J	K	Q	/Q
↗	0	0	Q	/Q
↗	0	1	0	1
↗	1	0	1	0
↗	1	1	/Q	Q
0	X	X	Q	/Q
1	X	X	Q	/Q

			!Q1	Q0	Q2	!Q2	Q1	!Q1
Q2	**Q1**	**Q0**	**J2**	**K2**	**J1**	**K1**	**J0**	**K0**
0	1	0	0	0	0	1	1	0
0	0	1						
0	0	0	1	0	0	1	0	1
1	0	0						
1	0	1	1	1	1	0	0	1
0	1	0						



Modo reloj – Ejercicio 6.4

Ejercicio 4. (ex. Julio 97) Dado el diagrama de estados de la figura 1, minimizarlo y completar el diagrama de tiempos de la figura 2, indicando el valor de la salida y el estado en cada ciclo de reloj.

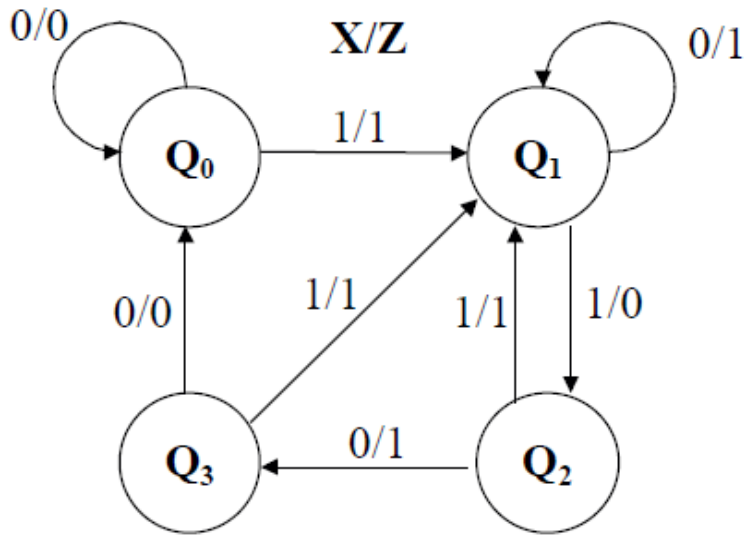


Figura 1

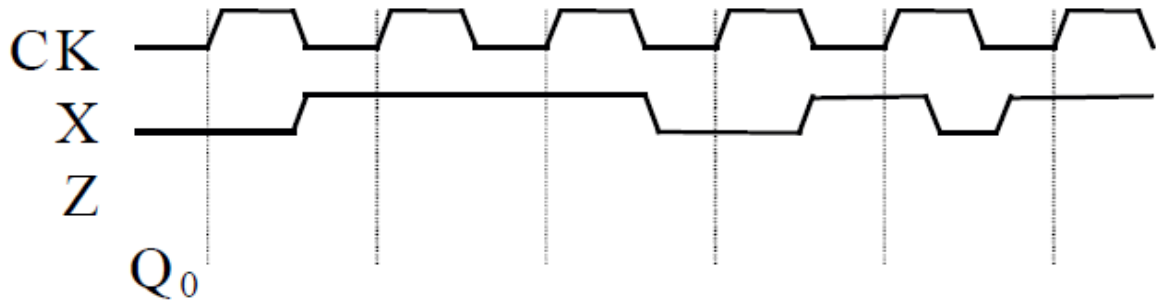
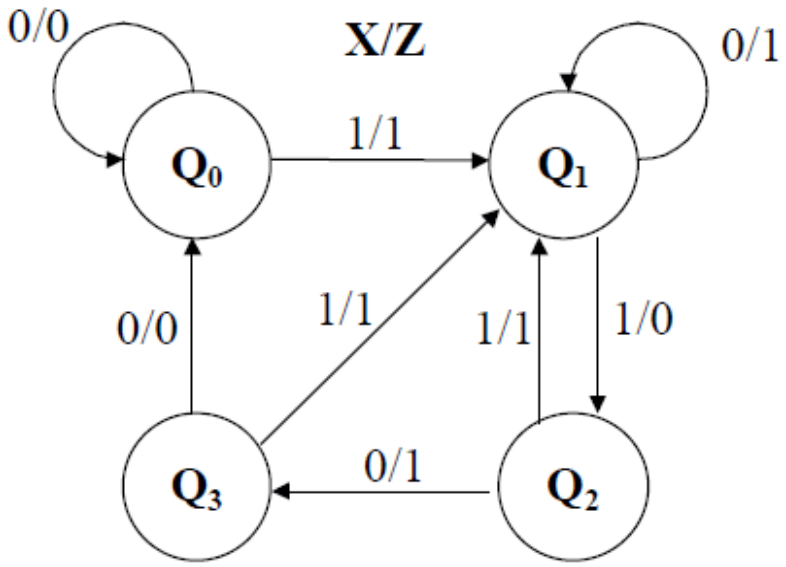


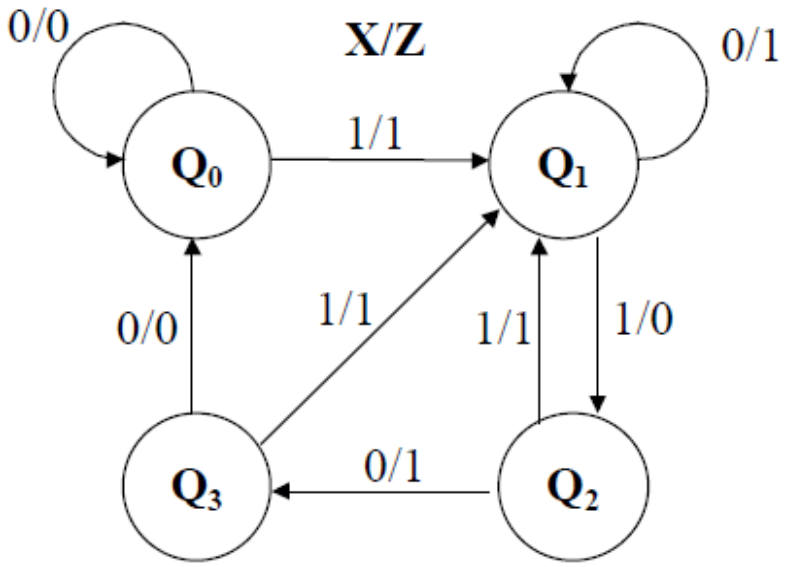
Figura 2

Tabla de Estados



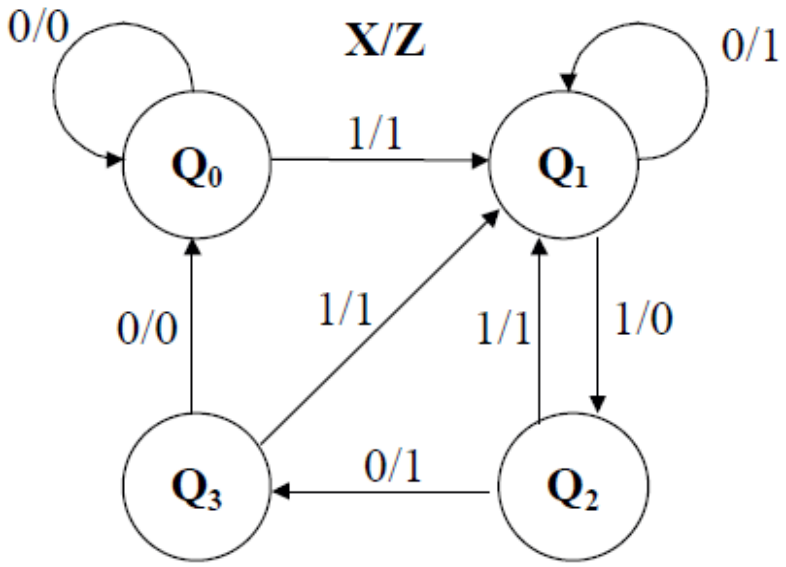
	Q(t+1)		Z(t)	
	X = 0	X = 1	X = 0	X = 1
Q0				
Q1				
Q2				
Q3				

Tabla de Estados



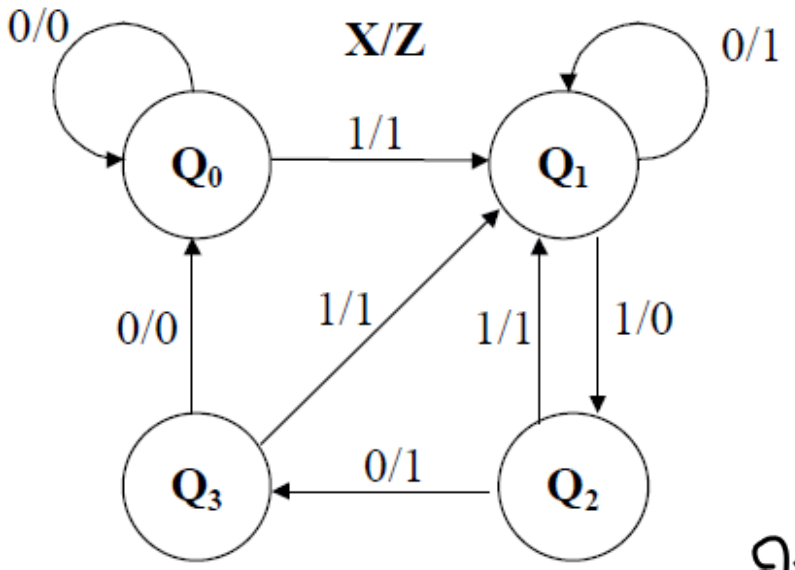
	Q(t+1)		Z(t)	
	X = 0	X = 1	X = 0	X = 1
Q0	Q0	Q1	0	1
Q1				
Q2				
Q3				

Tabla de Estados

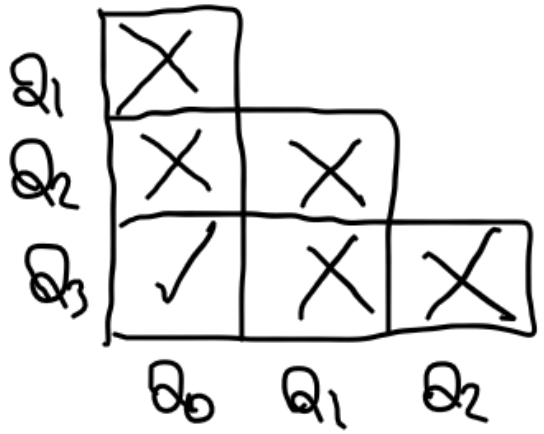


	Q(t+1)		Z(t)	
	X = 0	X = 1	X = 0	X = 1
Q0	Q0	Q1	0	1
Q1	Q1	Q2	1	0
Q2	Q3	Q1	1	1
Q3	Q0	Q1	0	1

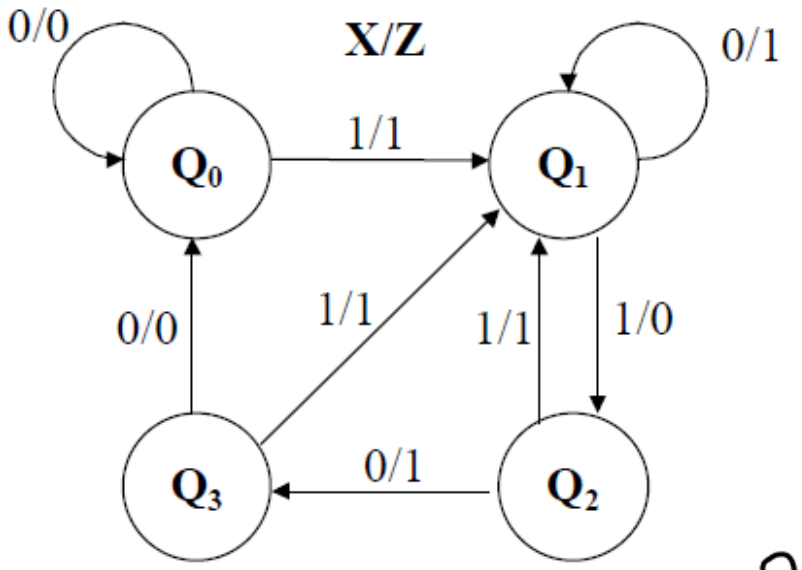
Minimización de Estados



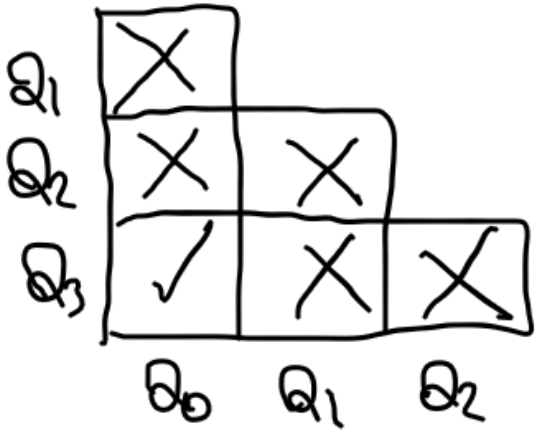
	Q(t+1)		Z(t)	
	X = 0	X = 1	X = 0	X = 1
Q0	Q0	Q1	0	1
Q1	Q1	Q2	1	0
Q2	Q3	Q1	1	1
Q3	Q0	Q1	0	1



Minimización de Estados

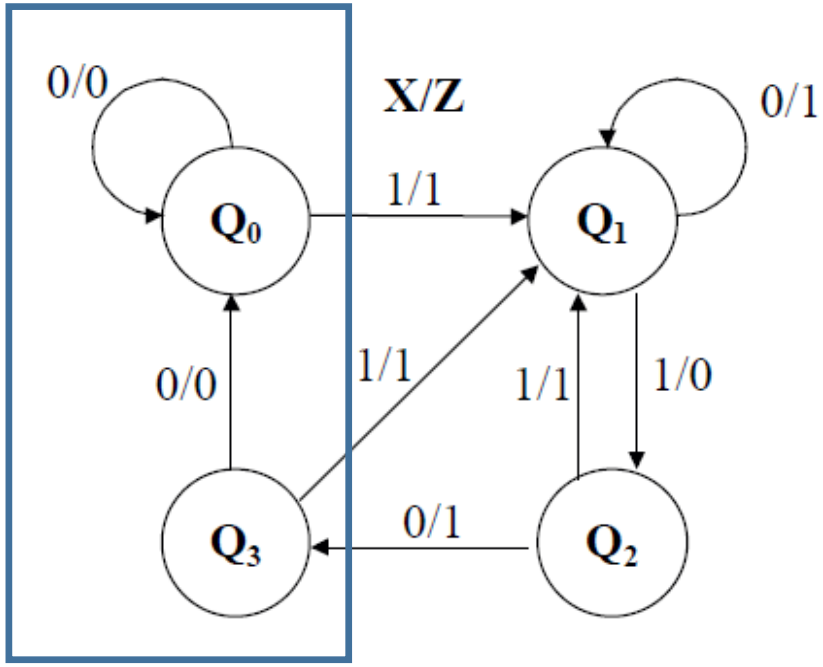


	Q(t+1)		Z(t)	
	X = 0	X = 1	X = 0	X = 1
Q0	Q0	Q1	0	1
Q1	Q1	Q2	1	0
Q2	Q3	Q1	1	1
Q3	Q0	Q1	0	1



Q0 y Q3 son estados equivalentes

Tabla de Estados Mínima



	Q(t+1)		Z(t)	
	X = 0	X = 1	X = 0	X = 1
Q0	Q0	Q1	0	1
Q1	Q1	Q2	1	0
Q2	Q0	Q1	1	1

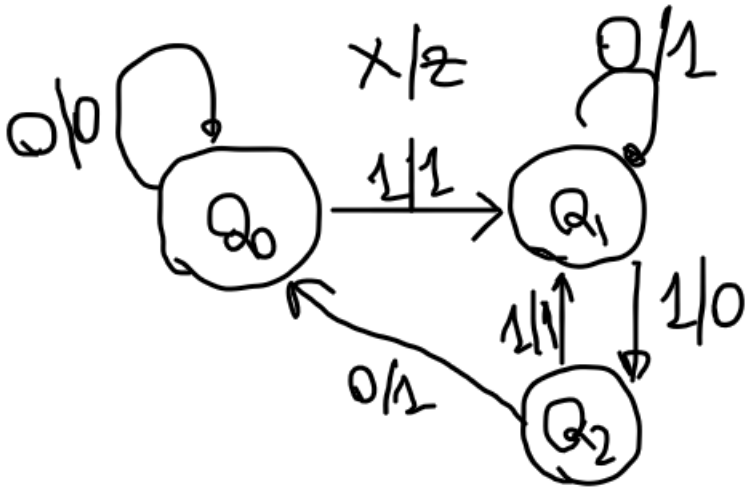
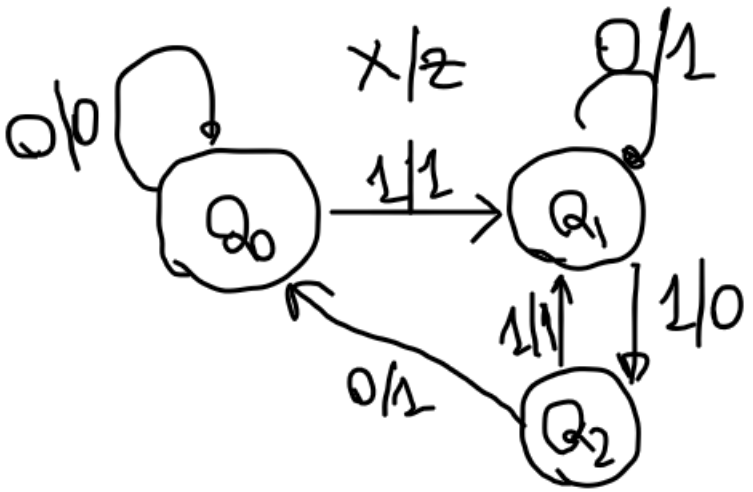


Diagrama de tiempos



	Q(t+1)		Z(t)	
	X = 0	X = 1	X = 0	X = 1
Q0	Q0	Q1	0	1
Q1	Q1	Q2	1	0
Q2	Q0	Q1	1	1

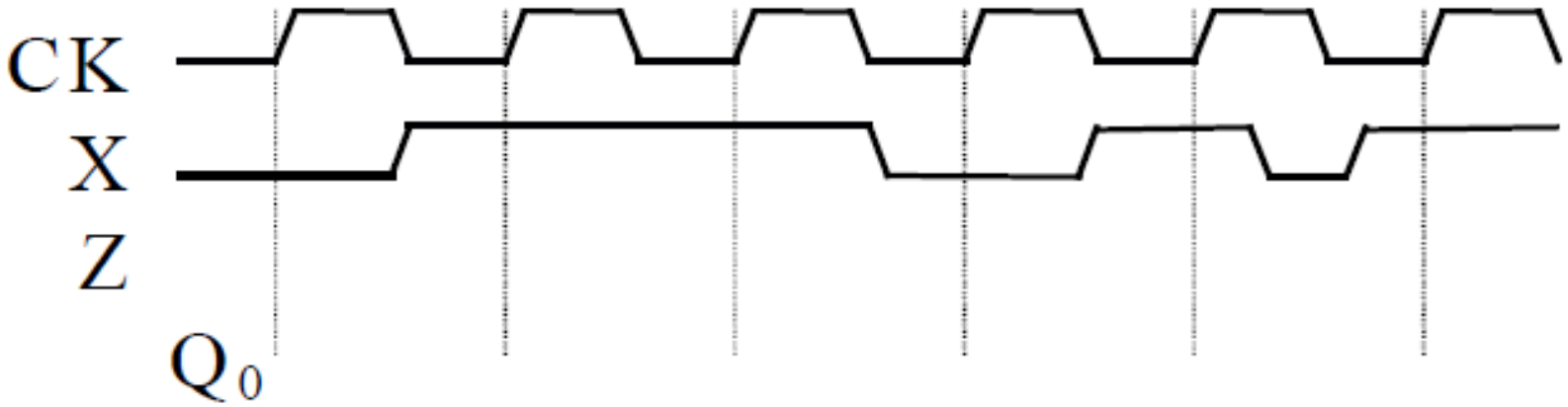
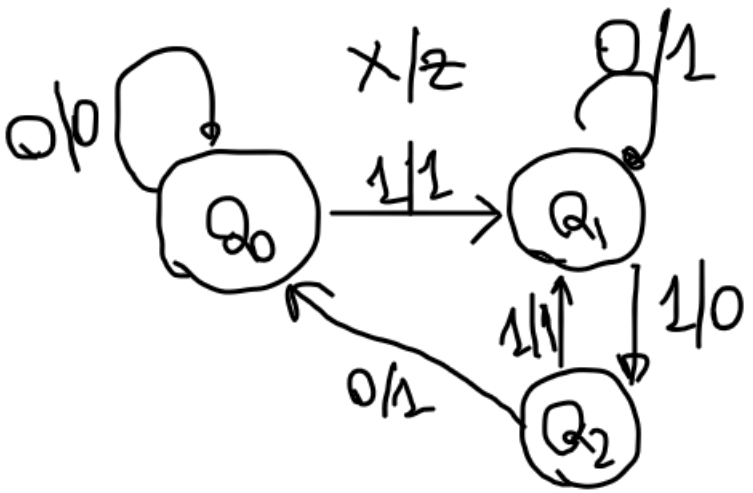


Diagrama de tiempos



	Q(t+1)		Z(t)	
	X = 0	X = 1	X = 0	X = 1
Q0	Q0	Q1	0	1
Q1	Q1	Q2	1	0
Q2	Q0	Q1	1	1

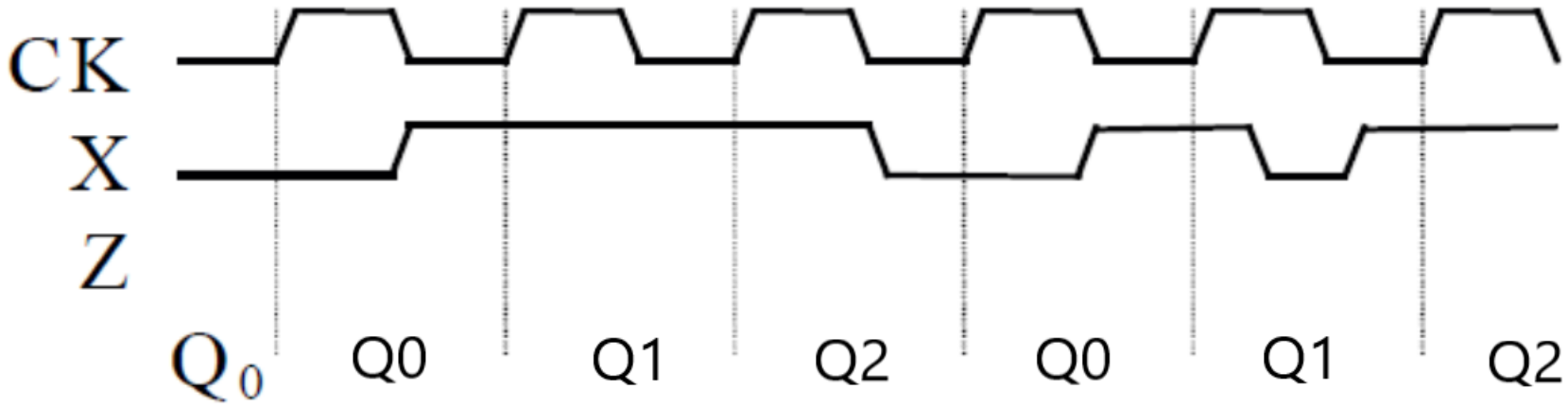
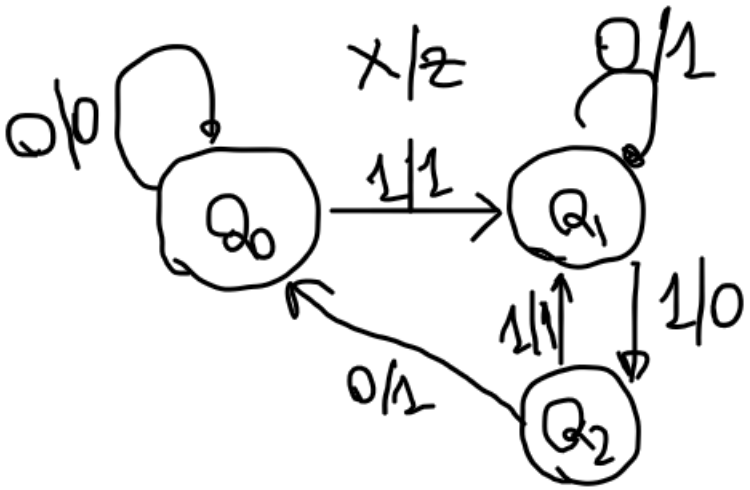
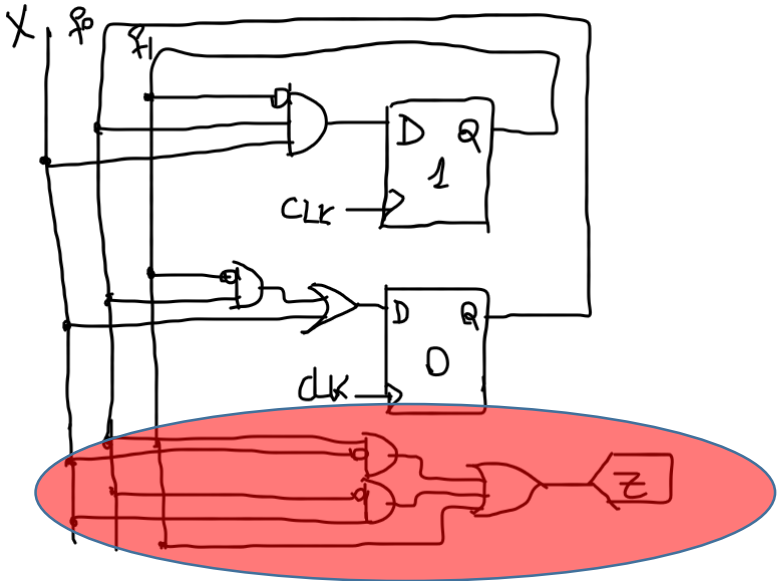


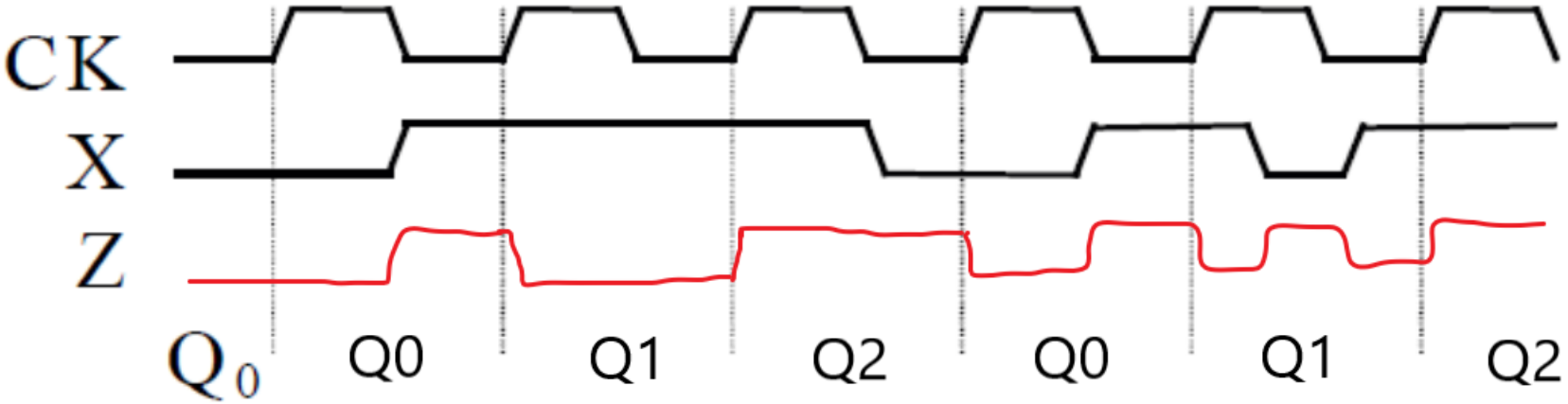
Diagrama de tiempos



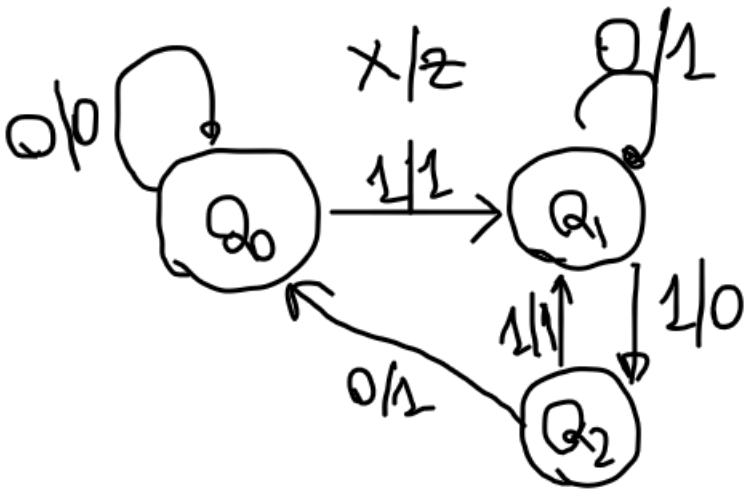
	Q(t+1)		Z(t)	
	X = 0	X = 1	X = 0	X = 1
Q0	Q0	Q1	0	1
Q1	Q1	Q2	1	0
Q2	Q0	Q1	1	1



LA SALIDA VARÍA CON LA ENTRADA (ES UN CIRCUITO COMBINATORIO, FUNCIÓN DEL ESTADO Y LAS ENTRADAS).



(Pasos para llegar al circuito)
Codificación de estados



	Q(t+1)		Z(t)	
	X = 0	X = 1	X = 0	X = 1
Q0	Q0	Q1	0	1
Q1	Q1	Q2	1	0
Q2	Q0	Q1	1	1

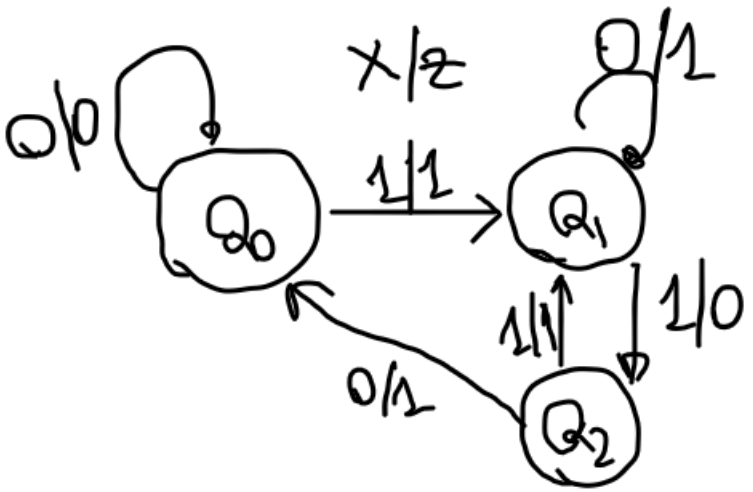
q1q0 Variables de Estado

Q0 – 00

Q1 – 01

Q2 - 11

Tabla de transiciones, elección de FF y Tabla de excitaciones



	Q(t+1)		Z(t)	
q1q0	X = 0	X = 1	X = 0	X = 1
00 Q0	00	01	0	1
01 Q1	01	11	1	0
11 Q2	00	01	1	1

Elijo FF D

q1q0 Variables de Estado

Q0 – 00

Q1 – 01

Q2 - 11

A partir de estas variables de estado y de la entrada, mapas K para salida y para entradas D1 y D0 de los FF, ecuaciones y circuito