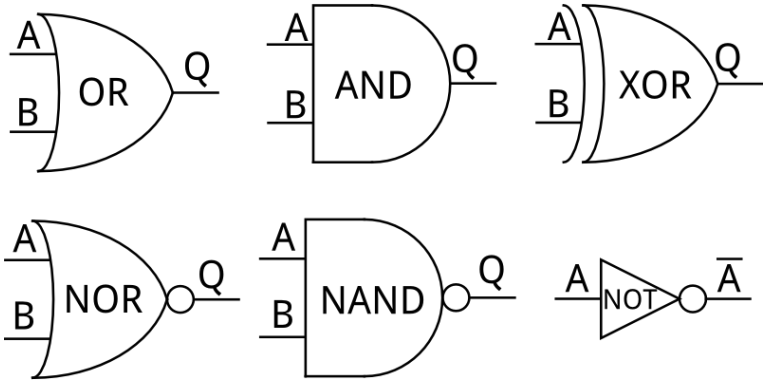
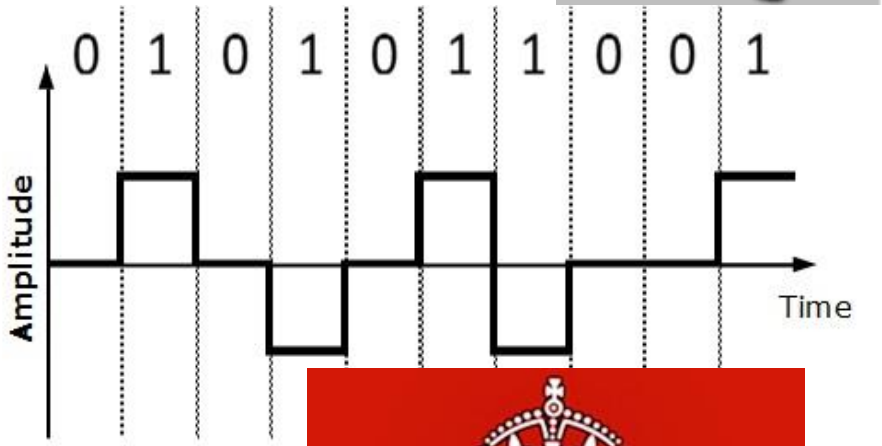
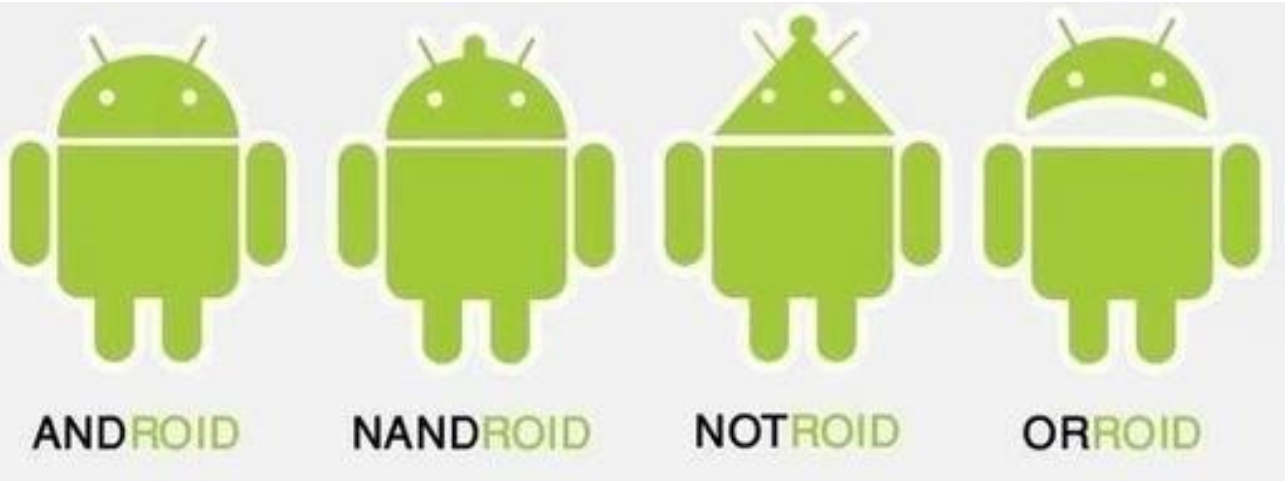
Proiectare Logica

Digital Logic Design

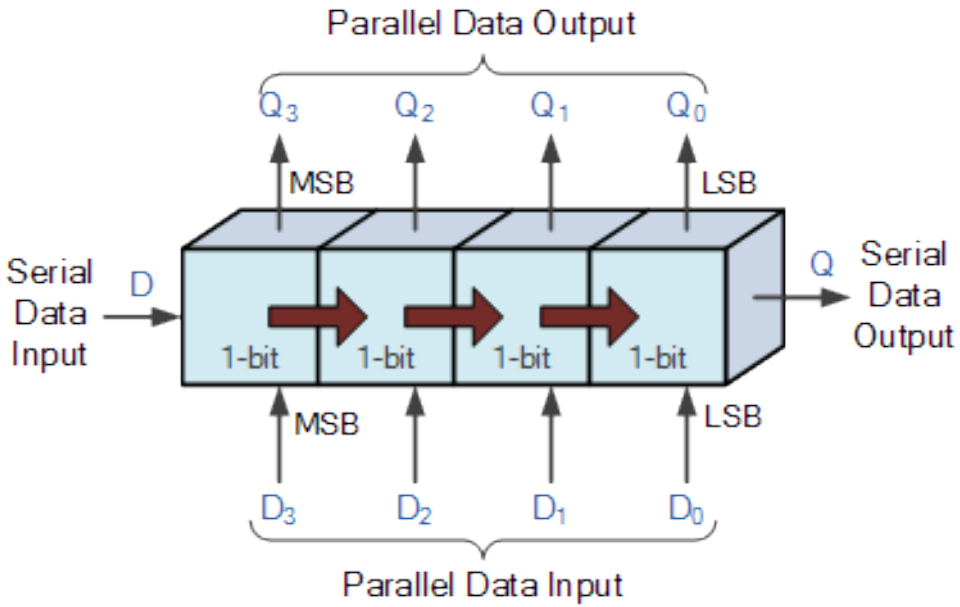
Curs 11







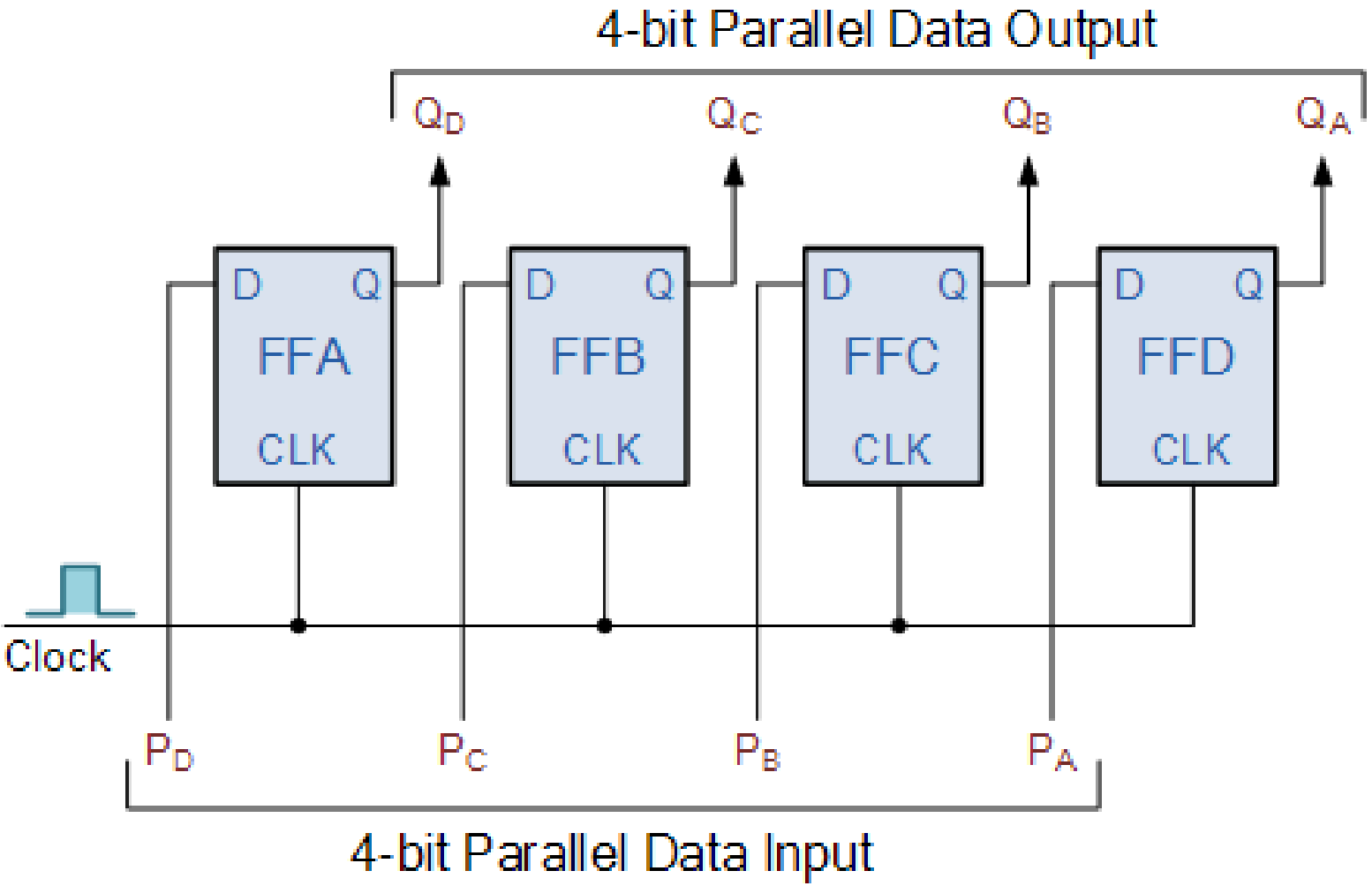
REGISTRII



- Seriali
- Paraleli
- Micsti

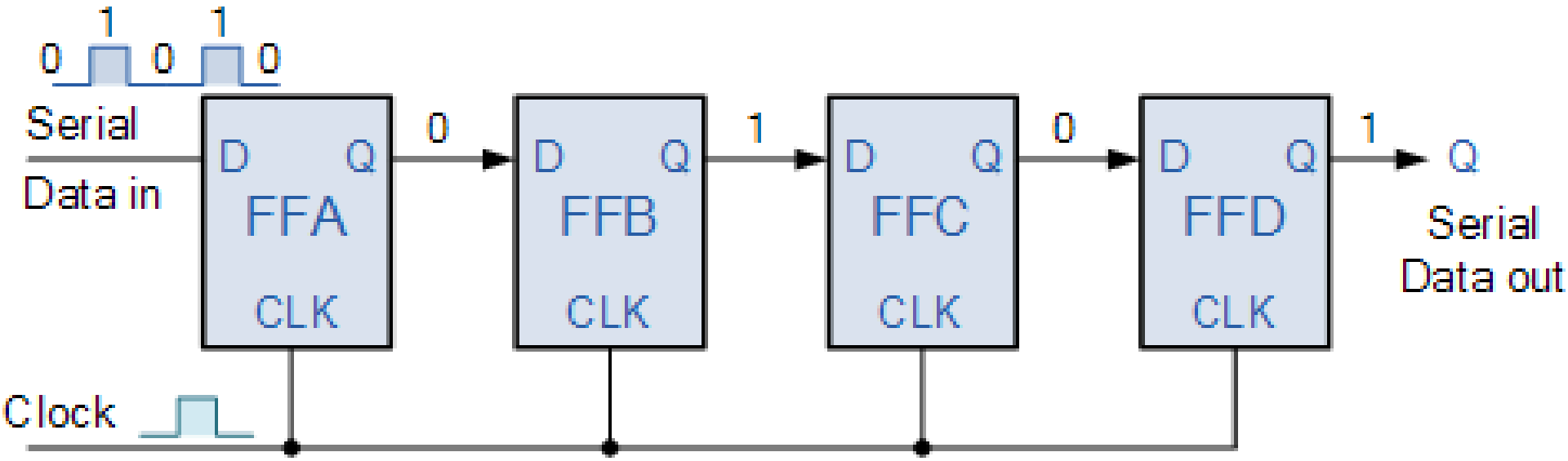
Registrii paraleli

- Cu BB de tip D



Registrii seriali

- Se mai numesc registrii de deplasare

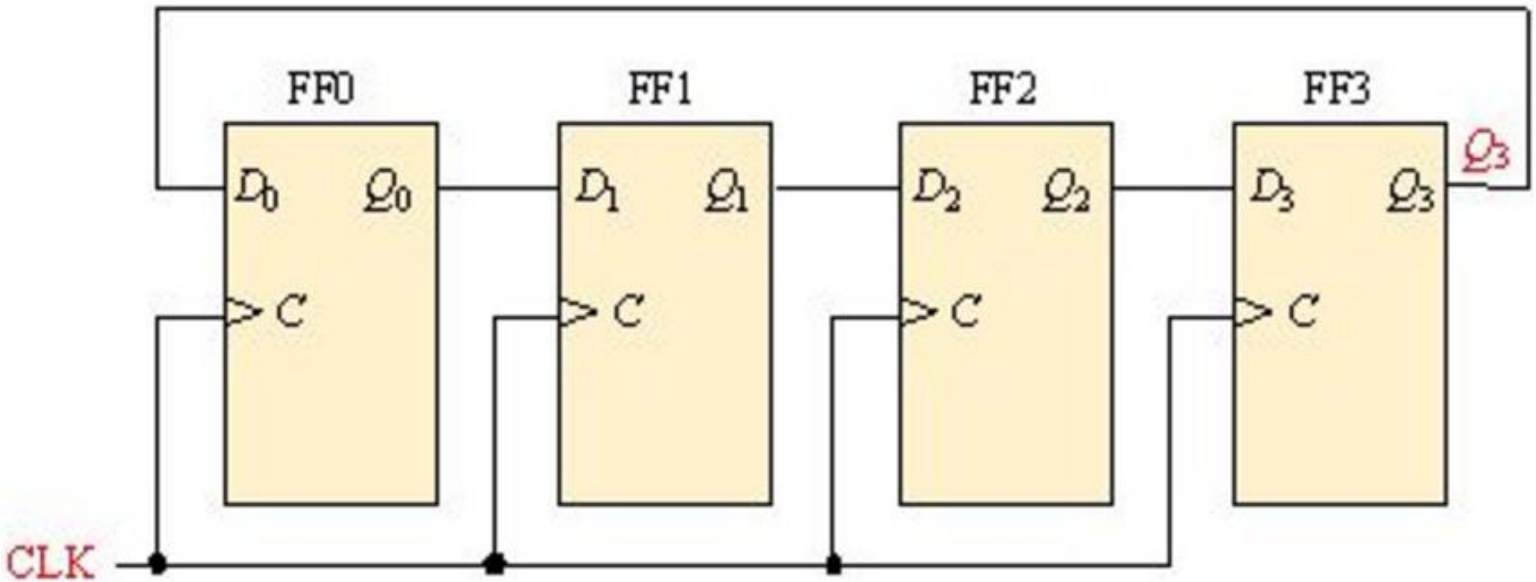


Registrii de deplasare circulara

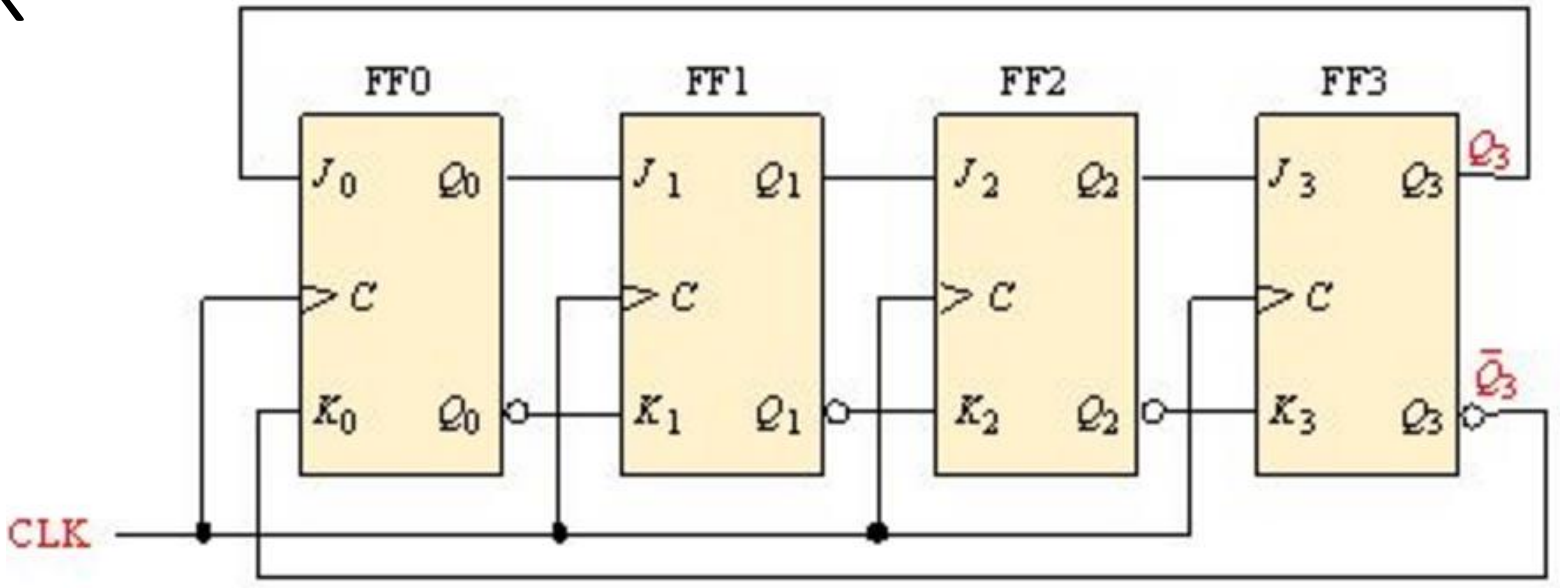
Ring counters

Numarator in inel

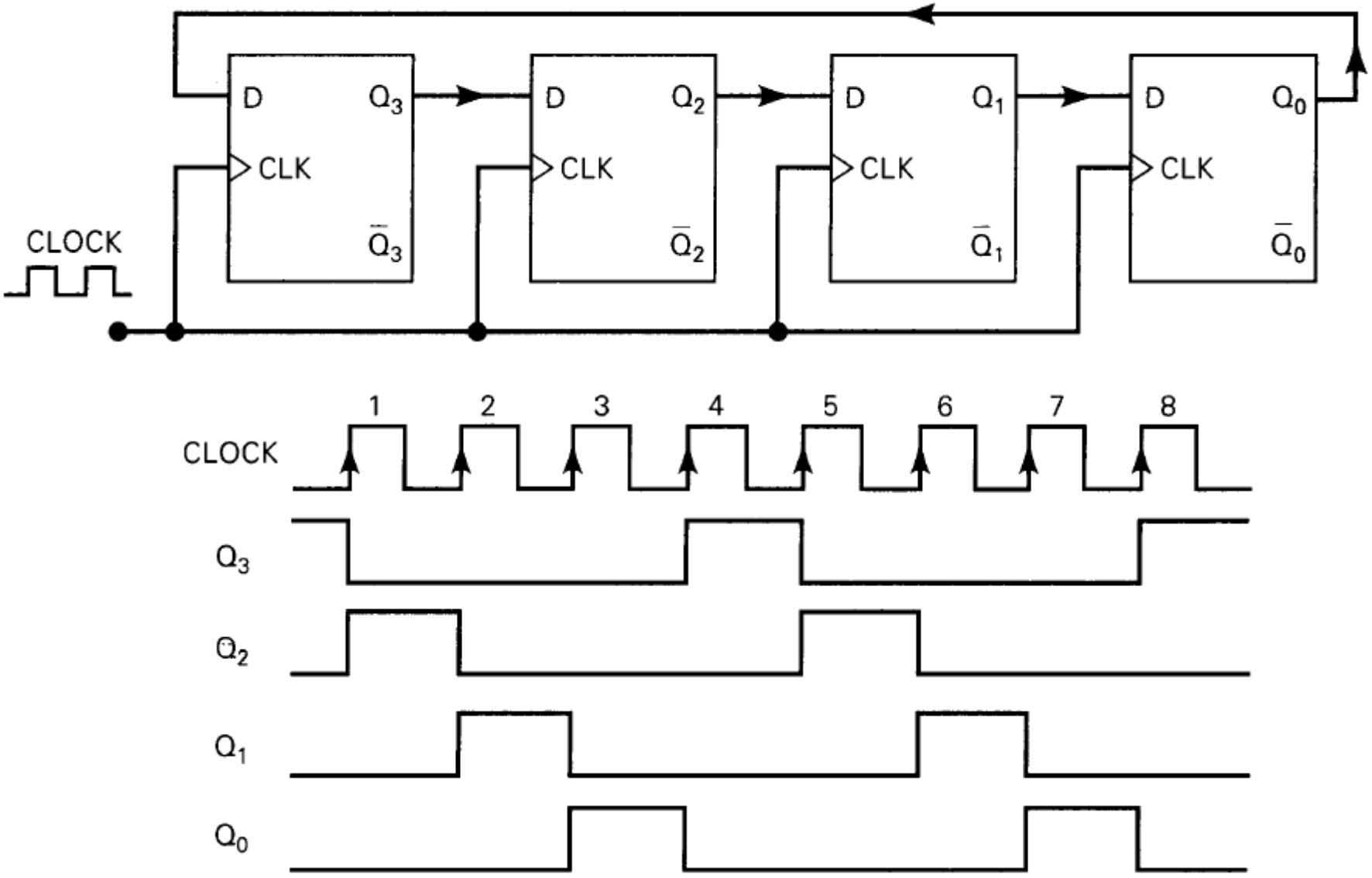
- Cu BB D



- Cu BB JK

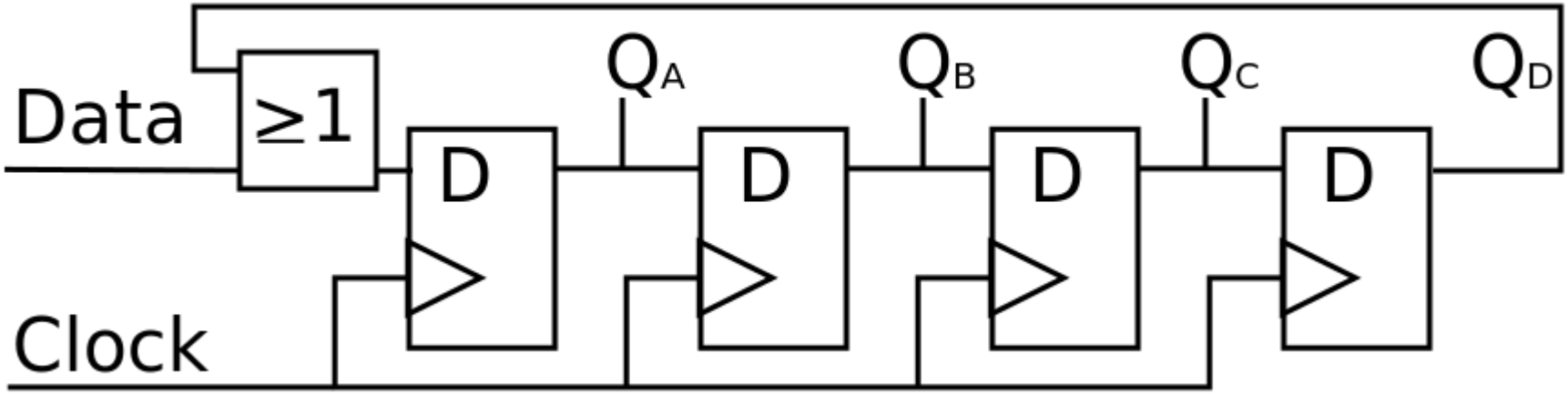


Registru de deplasare circular

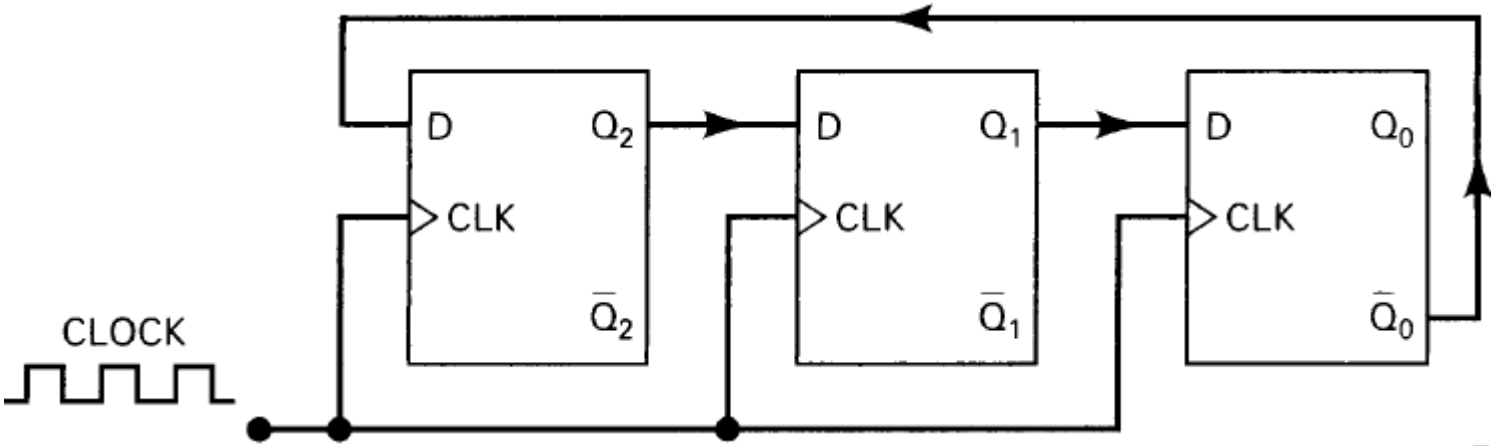


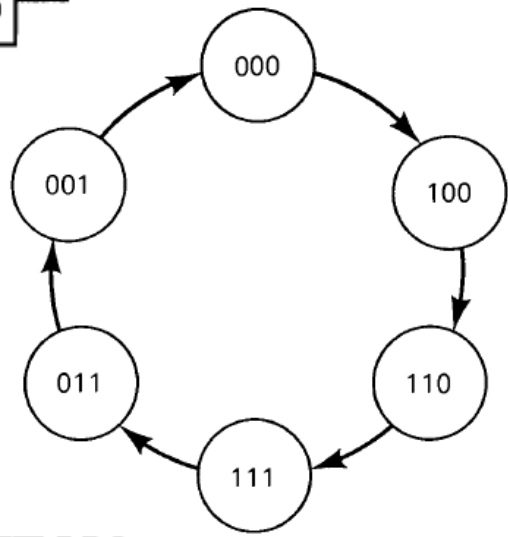
Registru de deplasare circular

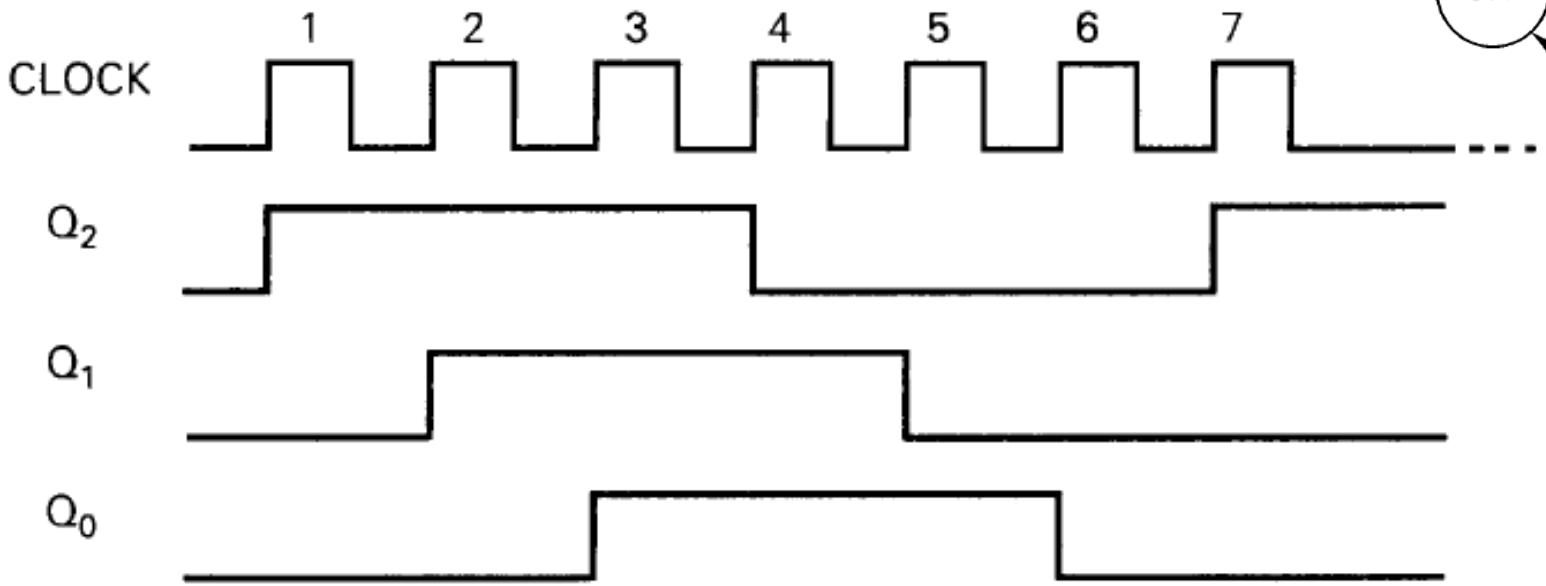
- Problema cu acest numarator este ca daca se "trezeste" in starea 0000 ramane acolo indefinit.
- O solutie de rezolvare a acestei problema este reprezentata in schema de mai jos.



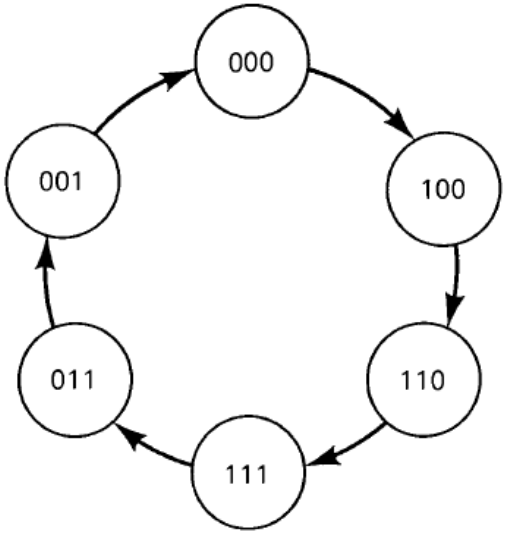
Numarator Johnson

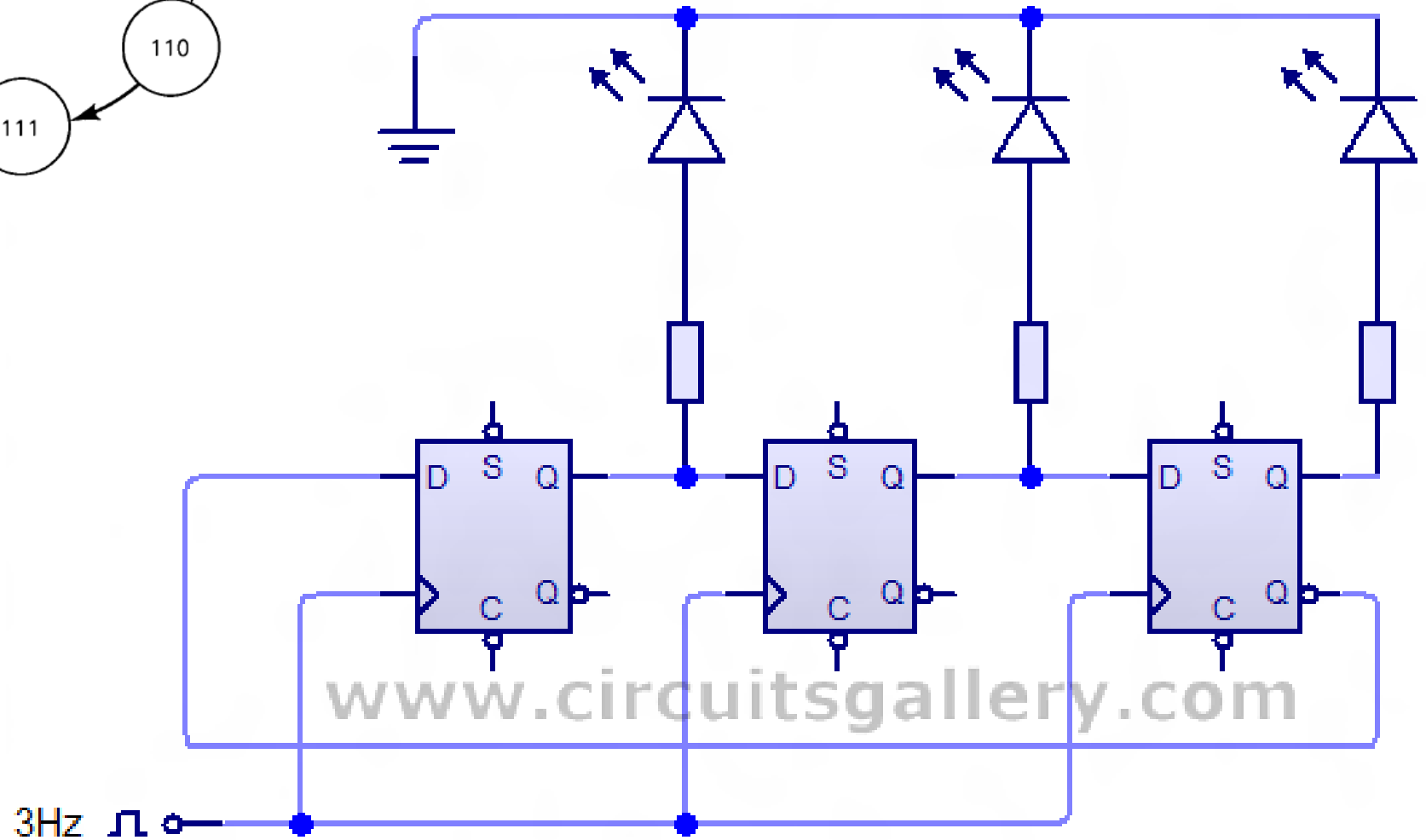




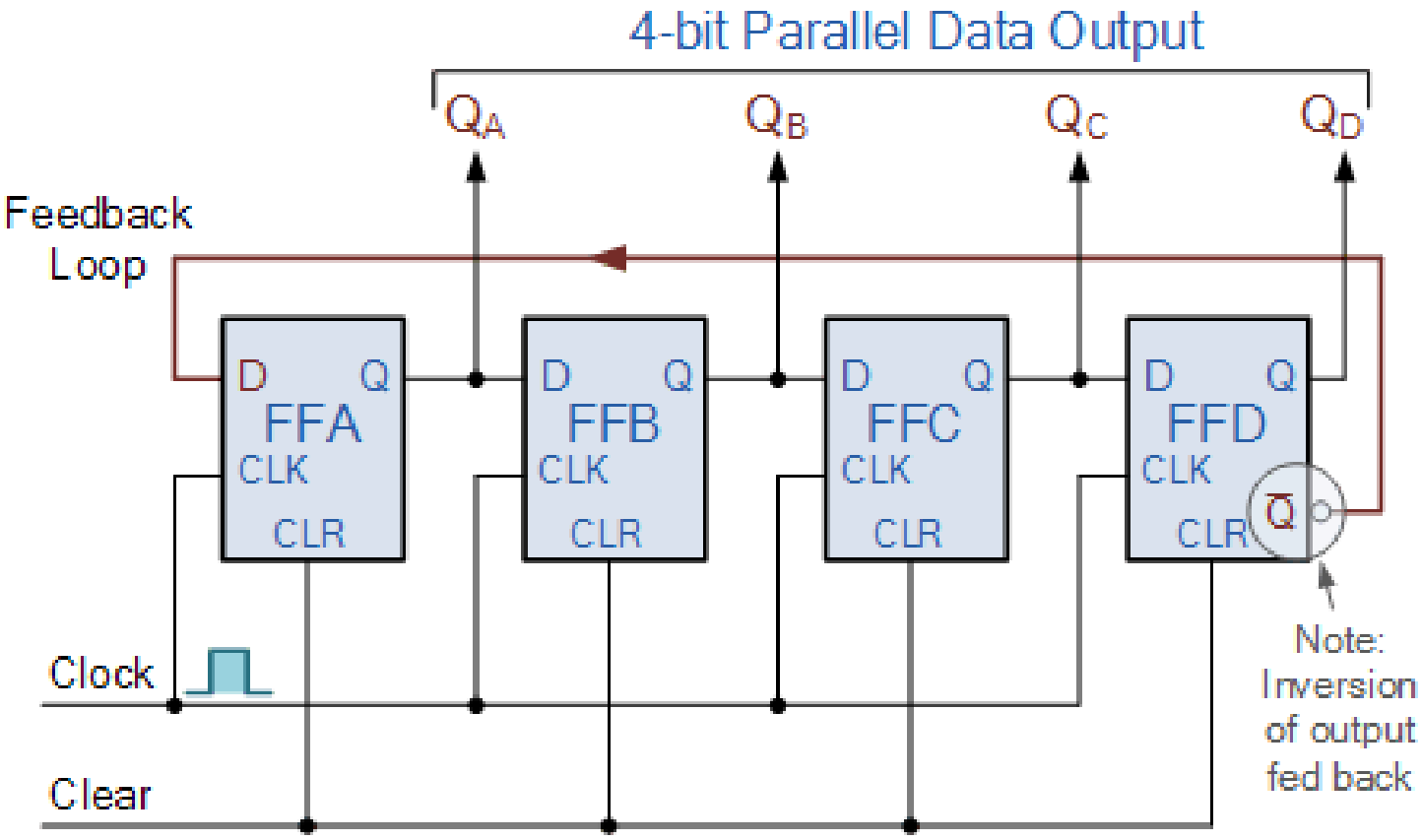


Numarator Johnson

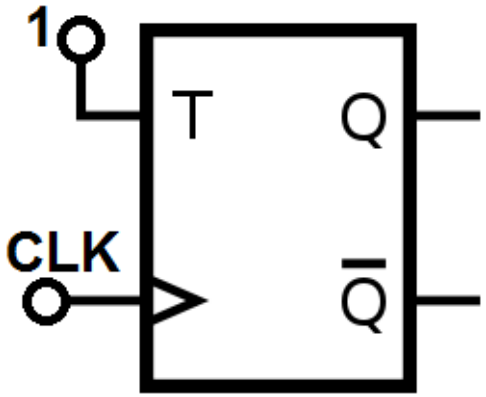




Numarator Johnson



TEMA: Folosind pagina "Generator_de_functii_de_unda_logice.htm" desenati formele de unda pentru semnalele CLOCK, CLEAR, A, B, C si D.



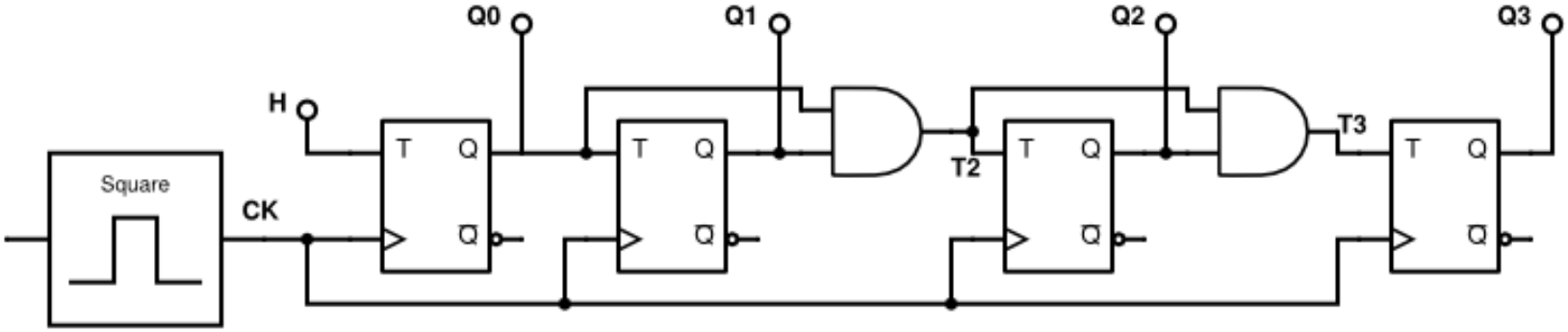
Inputs		Output	State
CLK	T	$Q_{(n+1)}$	
↑	0	Q_n	No Change
↑	1	not(Q_n)	Toggle

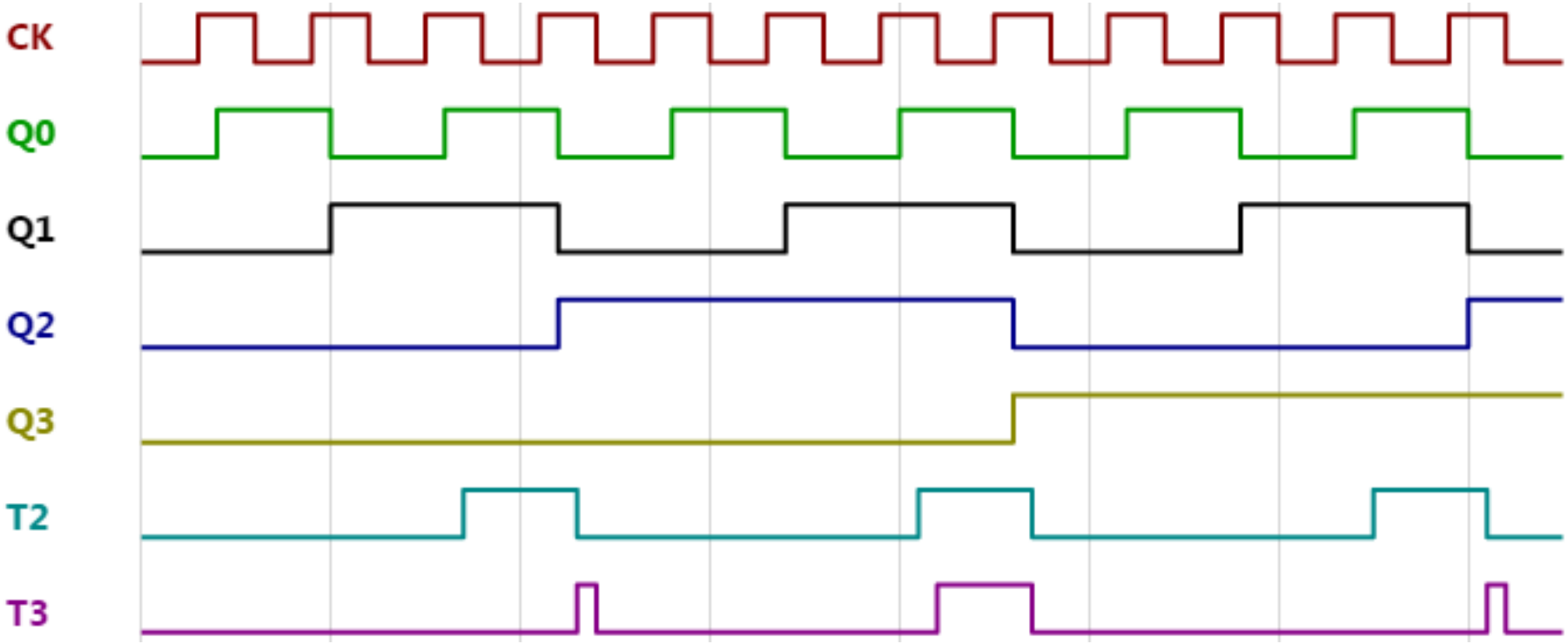
NUMARATOARE SINCRONE

Synchronous (Parallel) Counters

Numaratoare Sincrone

NU toti bistabilii au intrarile T conectate la H.





Numarator crescator cu 3 BB de tip D – D0

Dorim sa facem un numarator crescator cu 3 BB de tip D

Q2	Q1	Q0	D2	D1	D0
0	0	0	0	0	1
0	0	1	0	1	0
0	1	0	0	1	1
0	1	1	1	0	0
1	0	0	1	0	1
1	0	1	1	1	0
1	1	0	1	1	1
1	1	1	0	0	0

D0

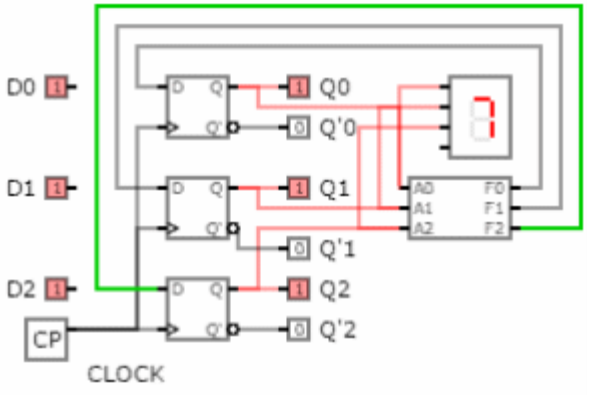


Tabela de adevar

A	B	C	F (ABC)
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

Diagrama Karnaugh

		AB			
		00	01	11	10
C	0	1	1	1	1
	1	0	0	0	0

$F(ABC) = \overline{C}$

$D0 = F0(Q2Q1Q0) = \overline{Q0}$

Numarator crescator cu 3 BB de tip D – D1

- Dorim sa facem un numarator cresctor cu 3 BB de tip D

Q2	Q1	Q0	D2	D1	D0
0	0	0	0	0	1
0	0	1	0	1	0
0	1	0	0	1	1
0	1	1	1	0	0
1	0	0	1	0	1
1	0	1	1	1	0
1	1	0	1	1	1
1	1	1	0	0	0

D1

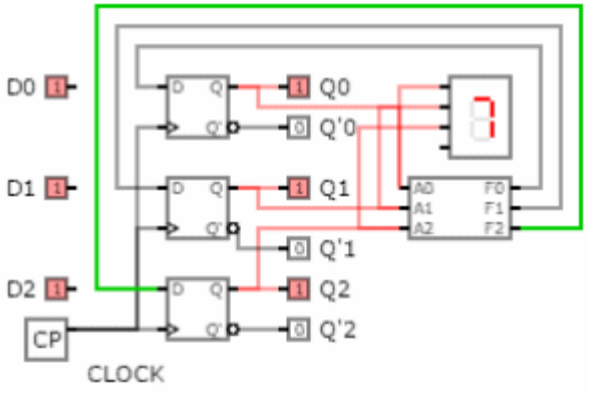


Tabela de adevar

A	B	C	F (ABC)
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

Diagrama Karnaugh

		AB			
		00	01	11	10
C	0	0	1	1	0
	1	1	0	0	1

$F(ABC) = B\,\overline{C} + \overline{B}\,C$

$D1 = F1(Q2Q1Q0) = Q1 \cdot \overline{Q0} + \overline{Q1} \cdot Q0$

Numarator crescator cu 3 BB de tip D – D2

Dorim sa facem un numarator crescator cu 3 BB de tip D

Q2	Q1	Q0	D2	D1	D0
0	0	0	0	0	1
0	0	1	0	1	0
0	1	0	0	1	1
0	1	1	1	0	0
1	0	0	1	0	1
1	0	1	1	1	0
1	1	0	1	1	1
1	1	1	0	0	0

D2

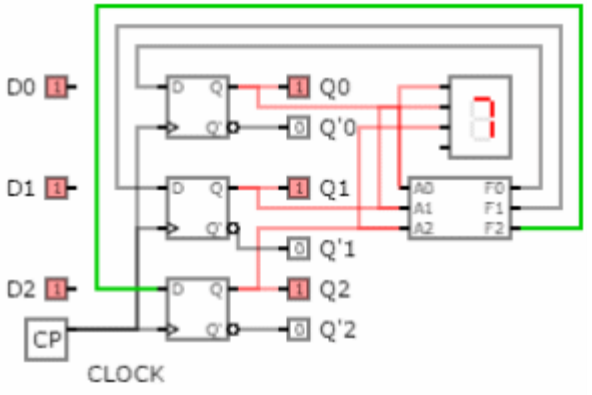


Tabela de adevar

A	B	C	F (ABC)
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

Diagrama Karnaugh

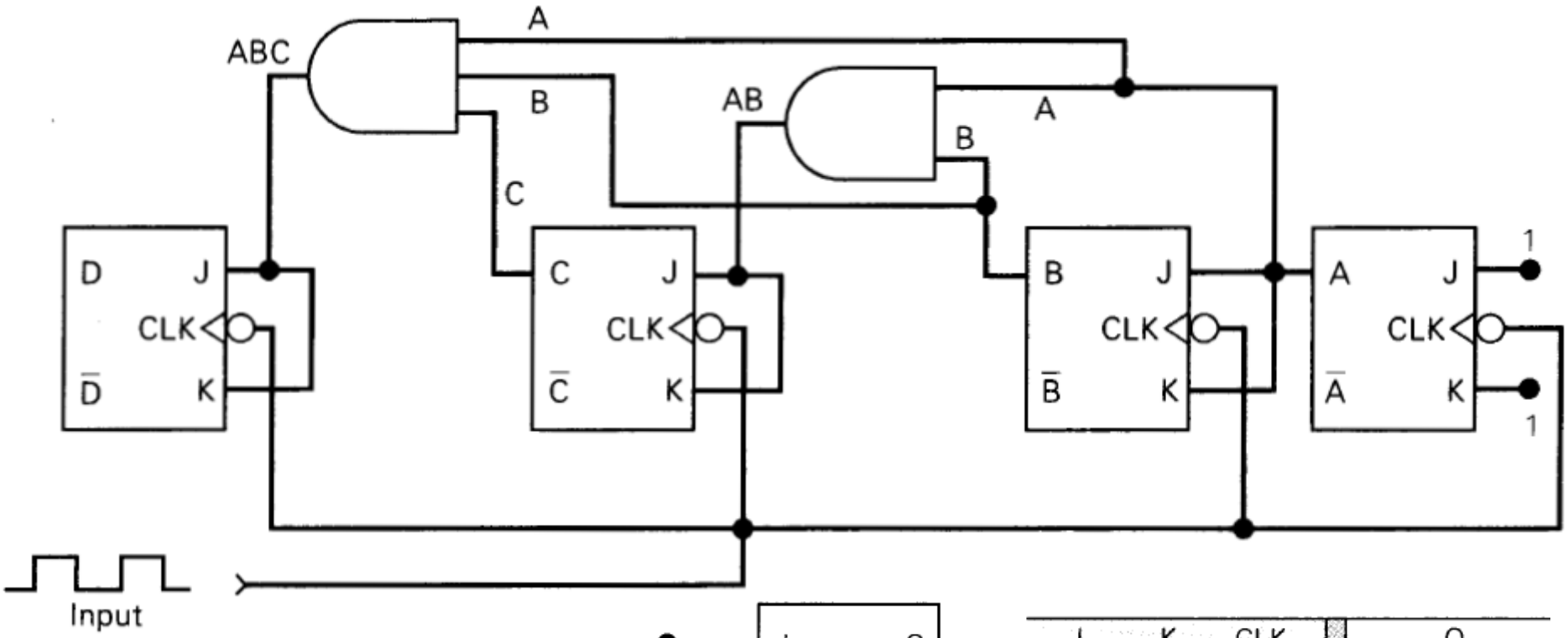
		AB			
		00	01	11	10
C	0	0	0	1	1
	1	0	1	0	1

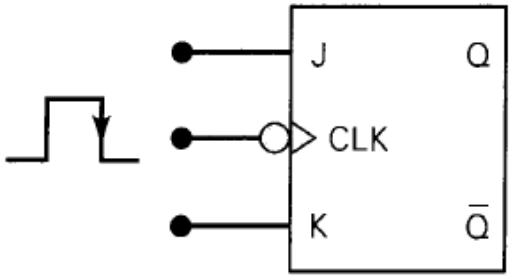
$F(ABC) = A\,\overline{C} + A\,\overline{B} + \overline{A}\,B\,C$

$D2 = F2(Q2Q1Q0) = Q2 \cdot \overline{Q0} + Q2 \cdot \overline{Q1} + \overline{Q2} \cdot Q1 \cdot Q0$

Numarator MOD 16 sincron

- **Toti bistabilii primesc simultan semnalul de ceas**
- Exista Circ. Logic Comb. pentru controlul numararii



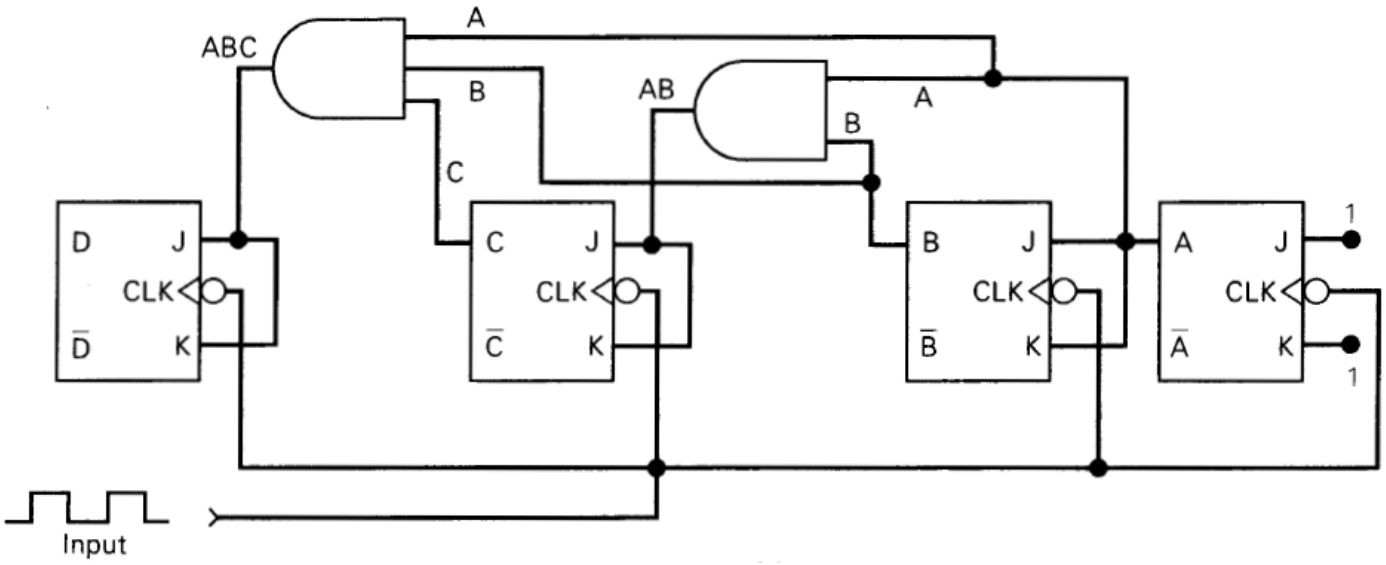


J	K	CLK	Q
0	0	↓	Q_0 (no change
1	0	↓	1
0	1	↓	0
1	1	↓	$\overline{Q_0}$ (toggles)

Numarator MOD 16 sincron (2)

- $JK_B = Q_A$
- $JK_C = Q_B\ Q_A$
- $JK_D = Q_C\ Q_B\ Q_A$

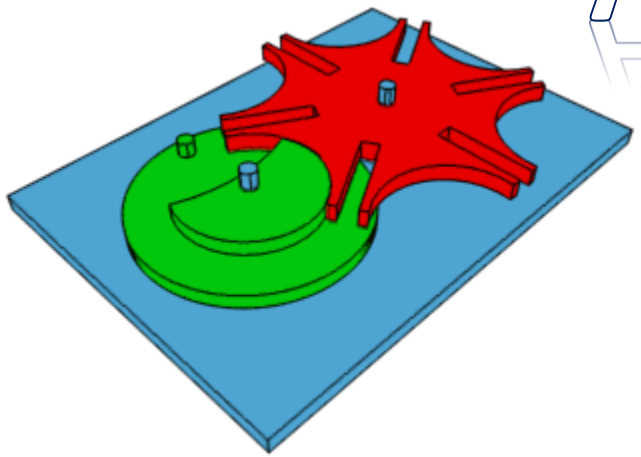
BB JK schimba starea numai cand JK=1

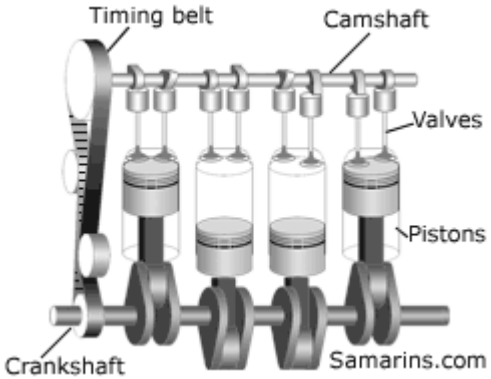


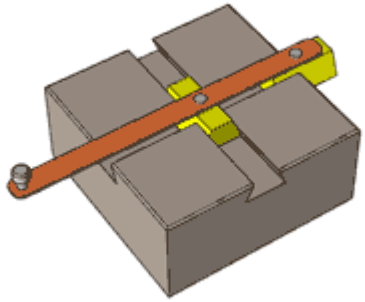
Count	D	C	B	A
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1
0	0	0	0	0

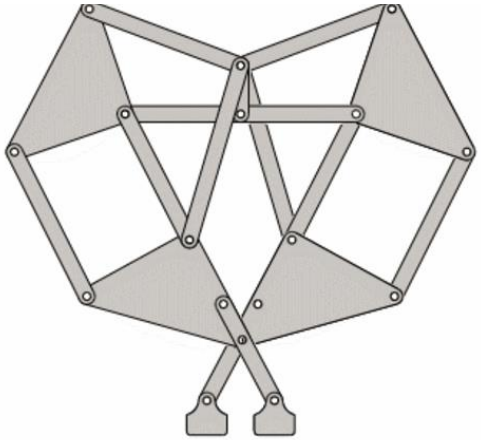
Fiecare BB are intrarile JK in HIGH
numai cand toti bistabilii anteriori sunt in HIGH.

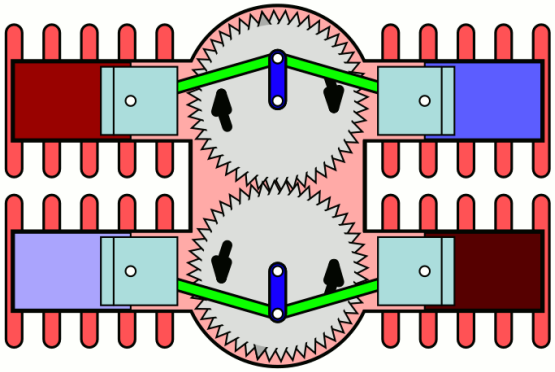
AUTOMATELE

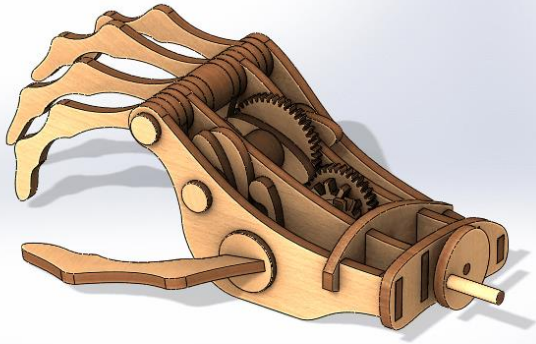








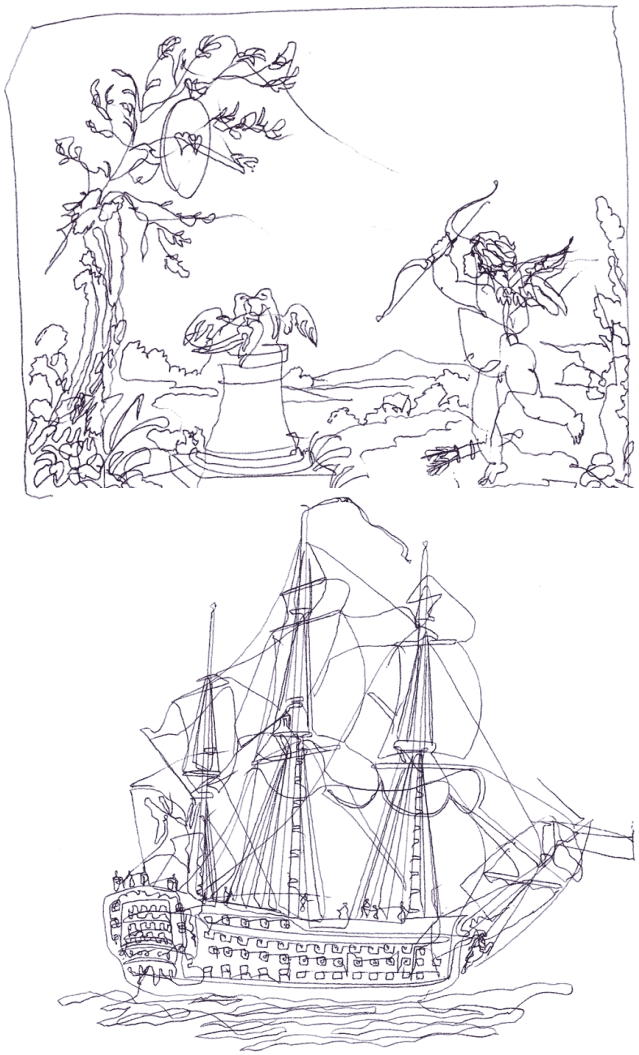




AUTOMATON - a machine which performs a range of functions according to a predetermined set of coded instructionss

Automate celebre

- Maillardet's automaton at the Franklin Institute.webm



Automat cu stari finite

Finite-State Machine (FSM) or Finite-State Automaton

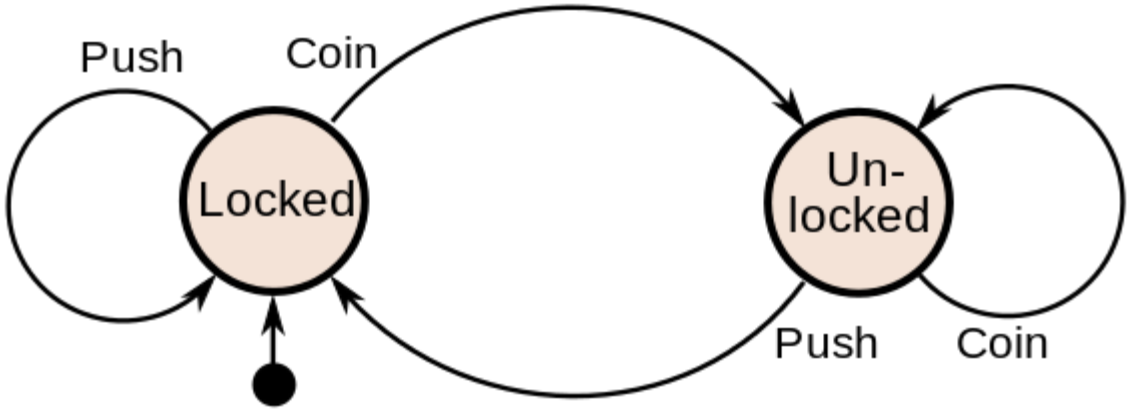


Diagrama de stari ⇔ Graf orientat

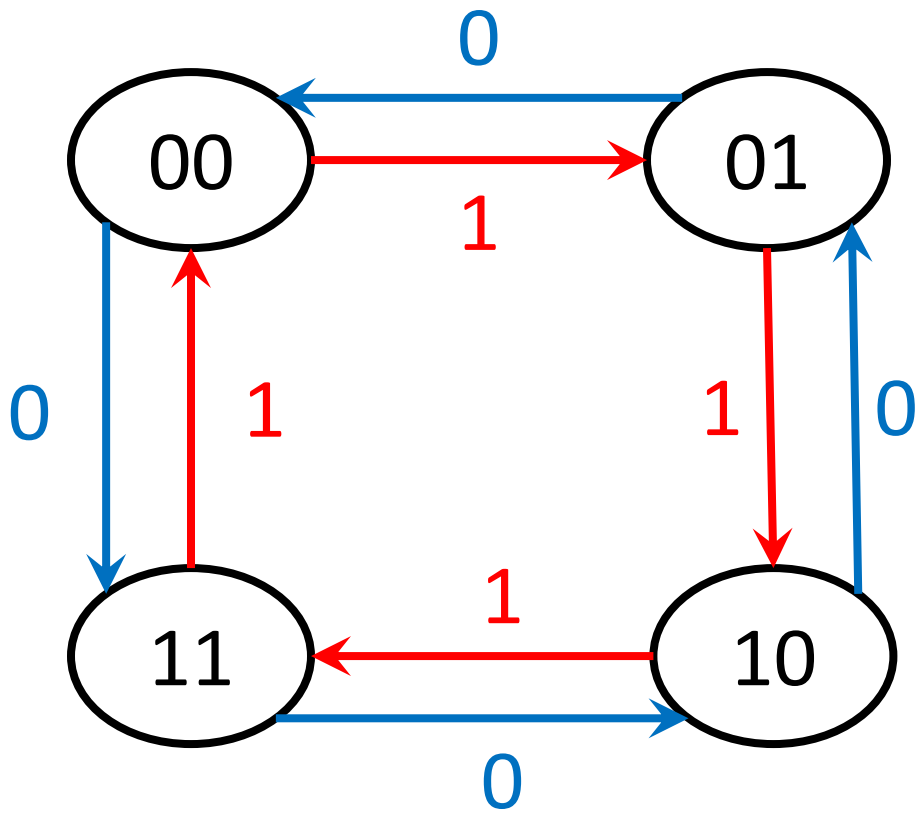
Noduri → Stari

Laturi →Variabile de intrare

Primul automat cu stari finite

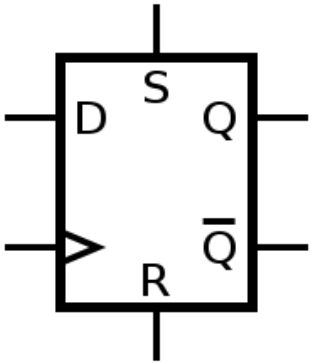
Fie un automat ale carui functionare depinde de starea unei variabile de intrare notata cu X.

- Daca X este in starea 1 atunci automatul numara direct
- Daca X este in starea 0 atunci automatul numara invers



Primul automat cu stari finite (2)

- Dorim sa construim acest automat cu bistabili de tip D. Intrucat sunt implicate 4 stari avem nevoie de doi bistabili de tip D.
- Problema noastra este de a construi circuite de reactie pentru intrarile D0 si D1.
- Mai precis avem nevoie sa derminam doua functii: D0=f(Q0,Q1,X) si D1=g(Q0,Q1,X)



S	R	D	CK	Q	$\overline{Q}$
1	0	-	-	1	0
0	1	-	-	0	1
1	1	1	↑	1	0
1	1	0	↑	0	1

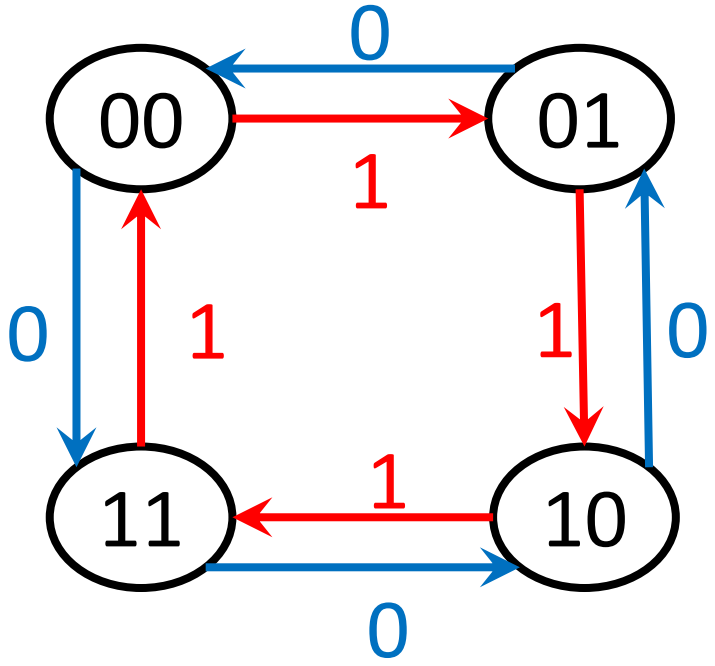
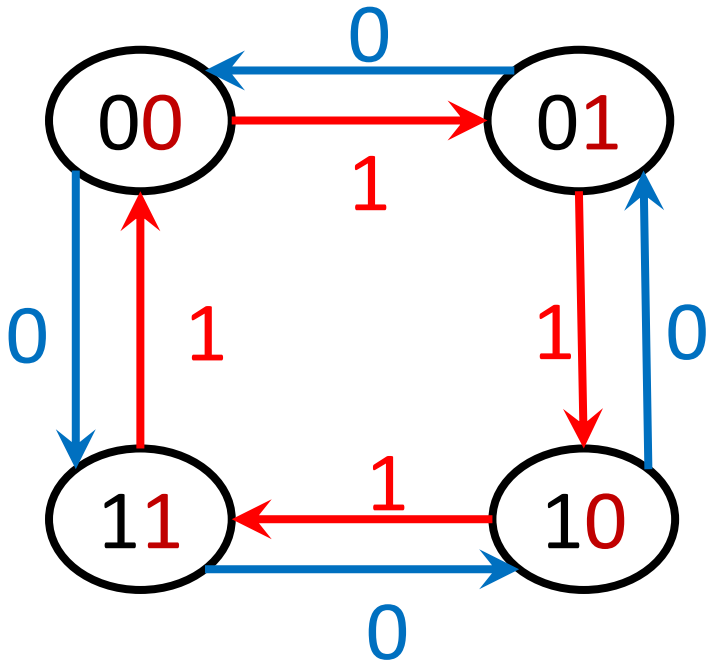


Diagrama pentru D0

		X = 0	X = 1
Q_1Q_0	00	1	1
	01	0	0
	11	0	0
	10	1	1



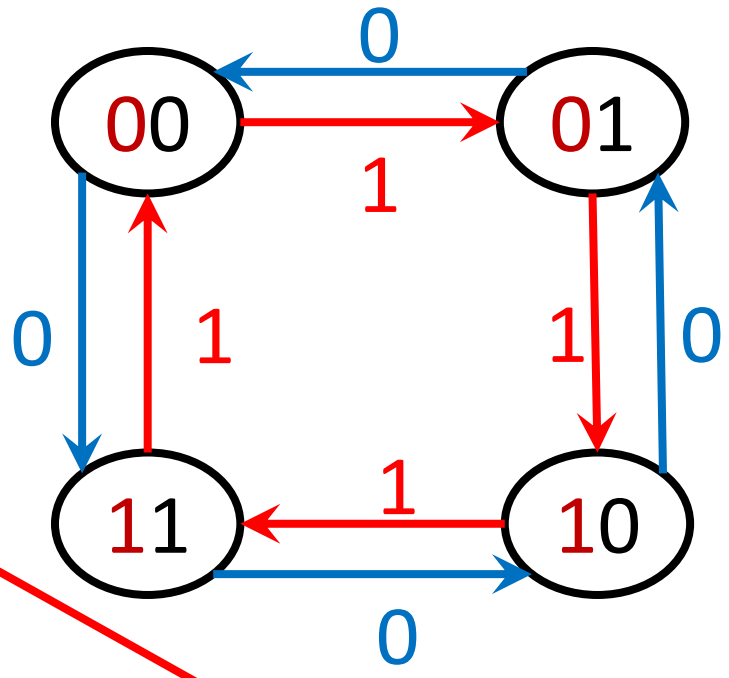
Viitoare Stari

$D_0 = \overline{Q_0}$

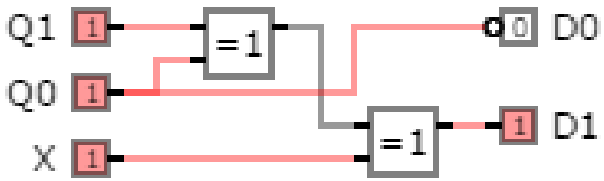
Nu depinde de X

Diagrama pentru D1

$D_1=$		X	
$(Q_1 \oplus Q_0) \oplus X$		0	1
Q_1Q_0	00	1	0
	01	0	1
	11	1	0
	10	0	1

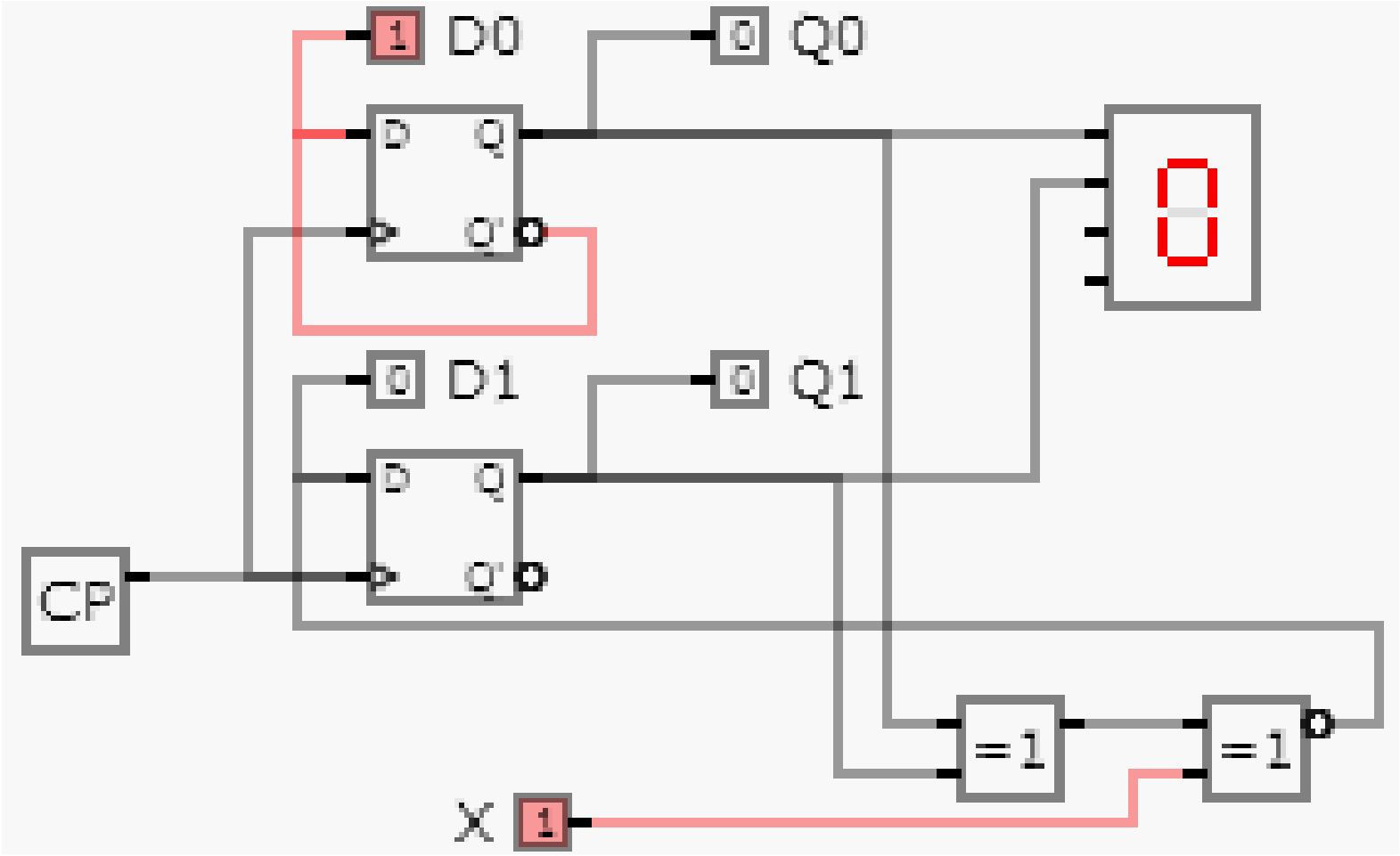


$$D_1=\overline{Q_1} \cdot \overline{Q_0} \cdot \bar{X} + Q_1 \cdot Q_0 \cdot \bar{X} + Q_1 \cdot \overline{Q_0} \cdot X + \overline{Q_1} \cdot Q_0 \cdot X$$

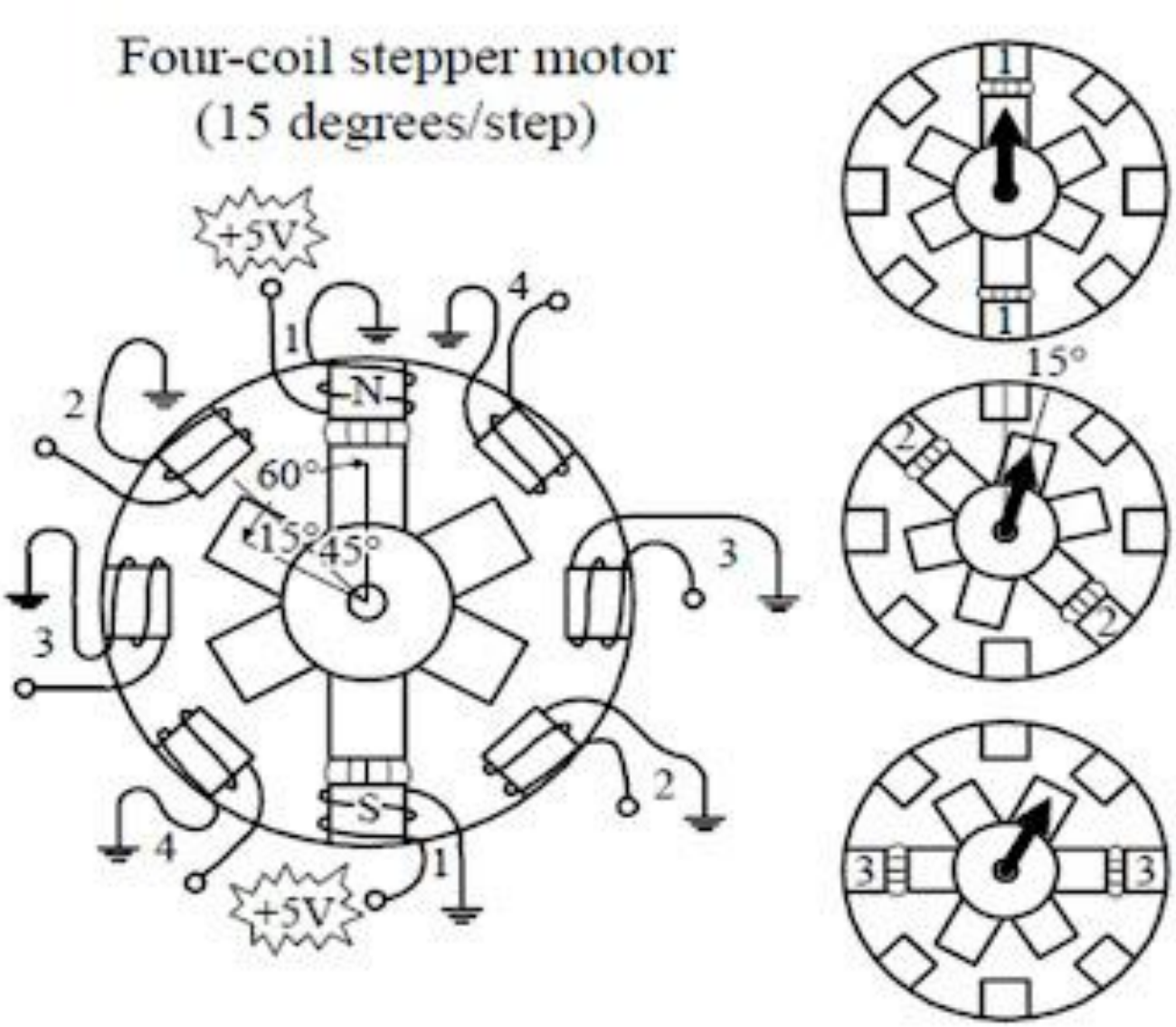


Simularea automatului

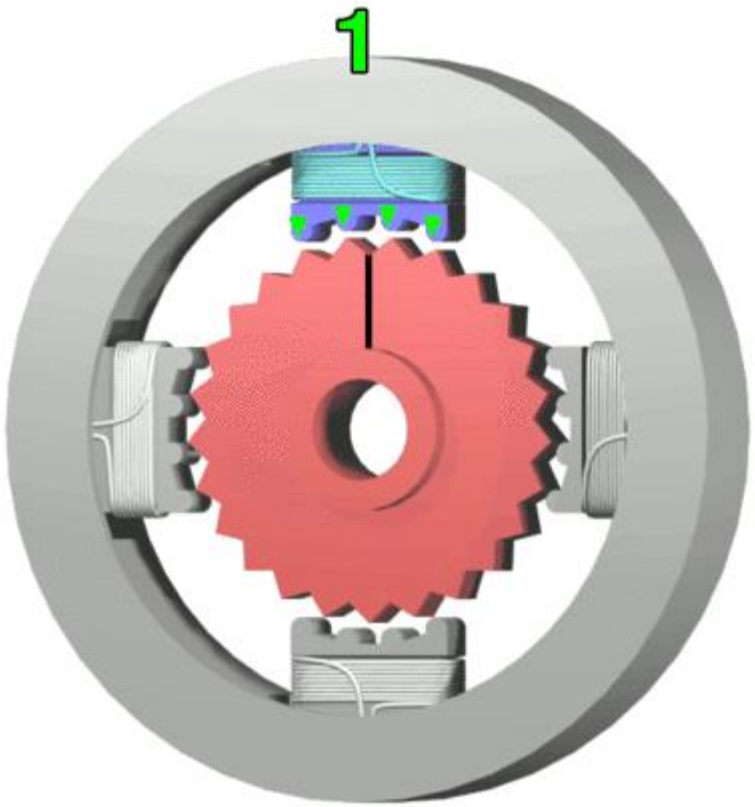
$D_0 = \overline{Q_0}$ $D_1 = \overline{(Q_1 \oplus Q_0) \oplus X}$

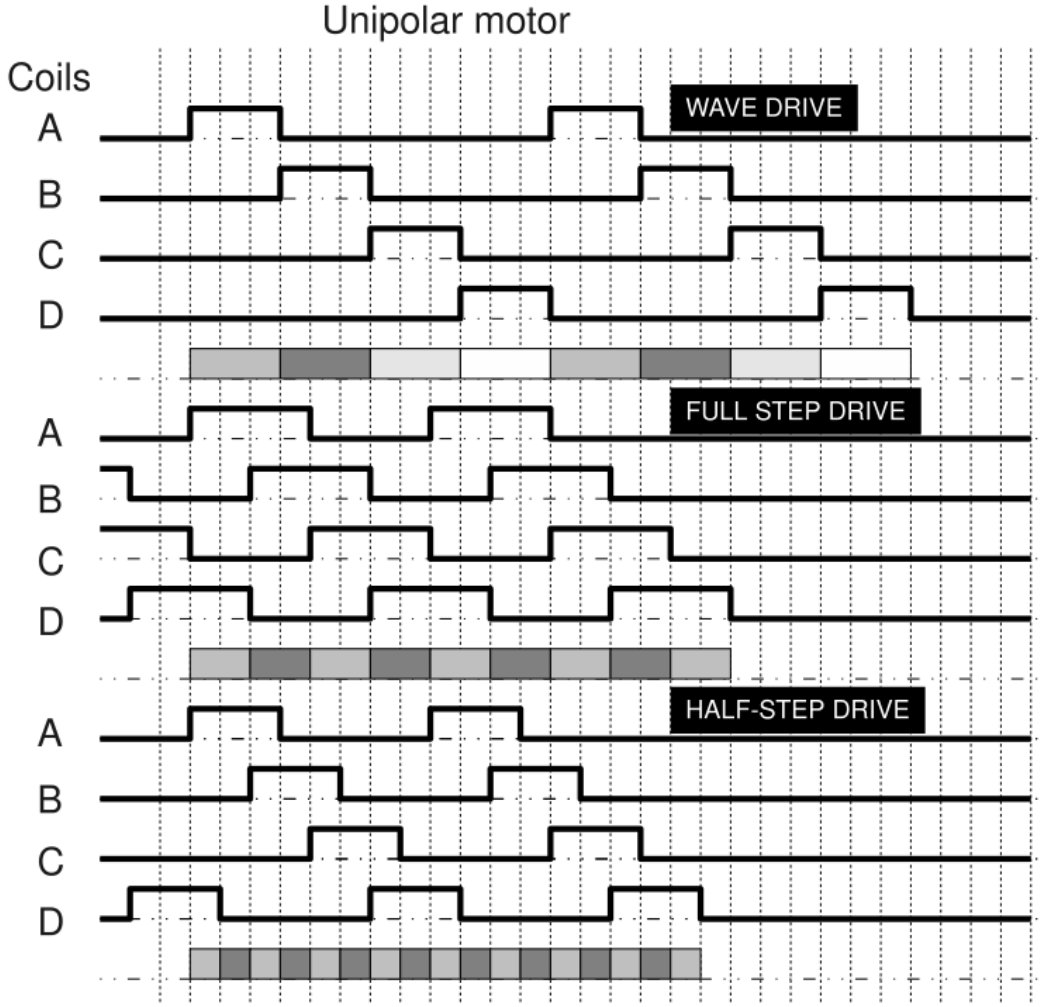


Comanda unui motor pas cu pas (Stepper motor) 1



Comanda unui motor pas cu pas (Stepper motor) 2



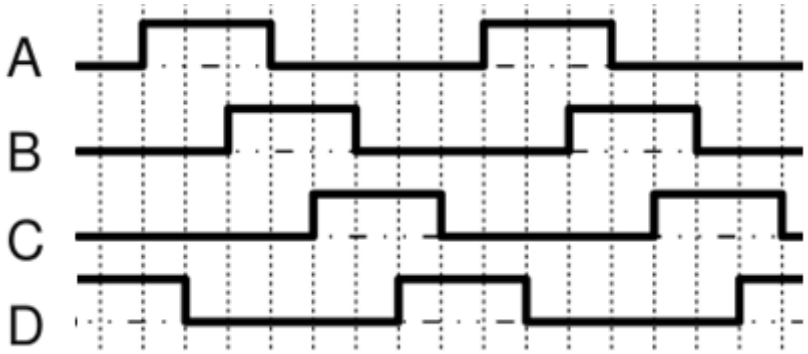


Challenge

Pentru **un bonus la nota de la examen** proiectati un automat ***optimal*** care sa numere circular

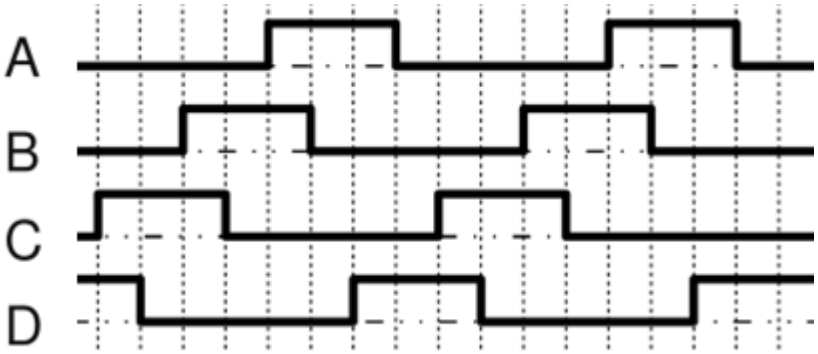
pentru X=0

A=(1,1,1,0,0,0,0,0)
B=(0,0,1,1,1,0,0,0)
C=(0,0,0,0,1,1,1,0)
D=(1,0,0,0,0,0,1,1)

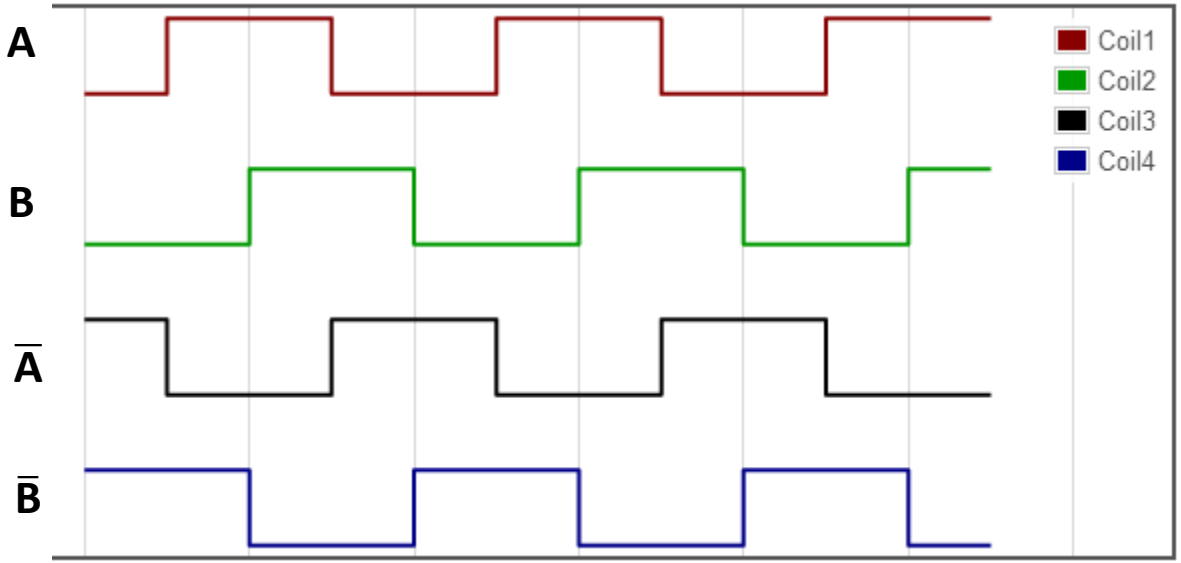


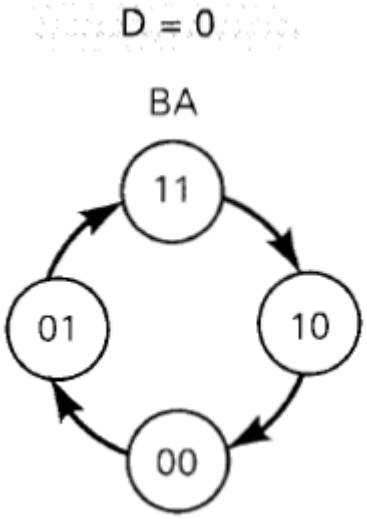
si X=1

A=(0,0,0,0,0,1,1,1)
B=(0,0,0,1,1,1,0,0)
C=(0,1,1,1,0,0,0,0)
D=(1,1,0,0,0,0,0,1)

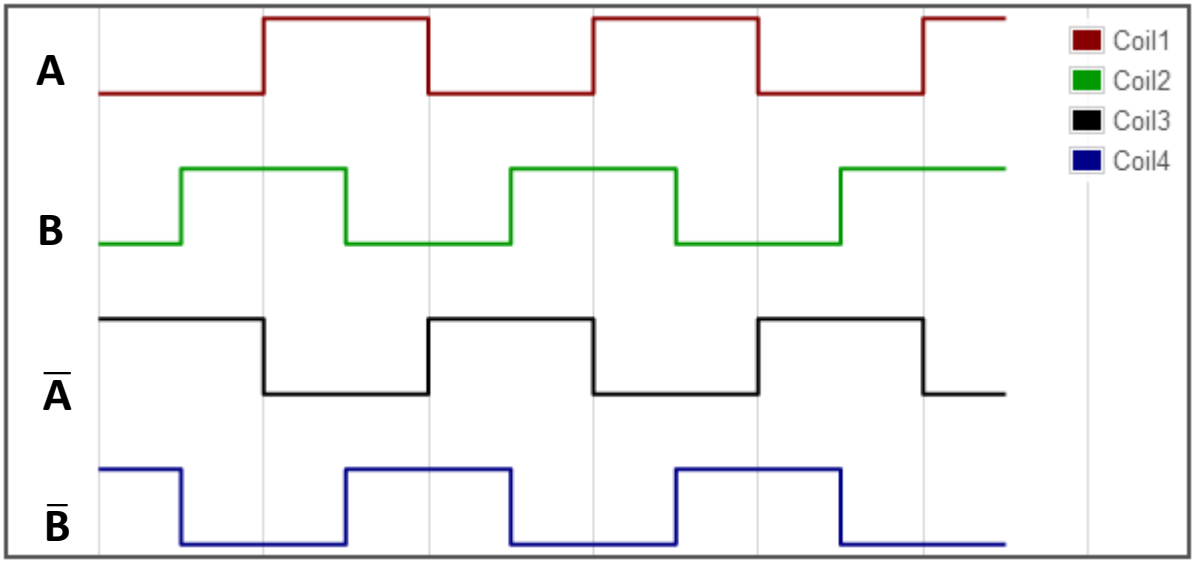


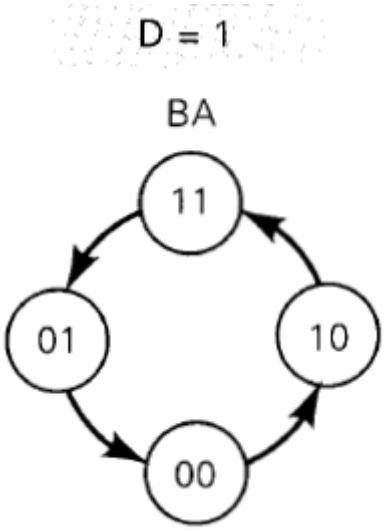
Comanda unui motor pas cu pas (Stepper motor) 3





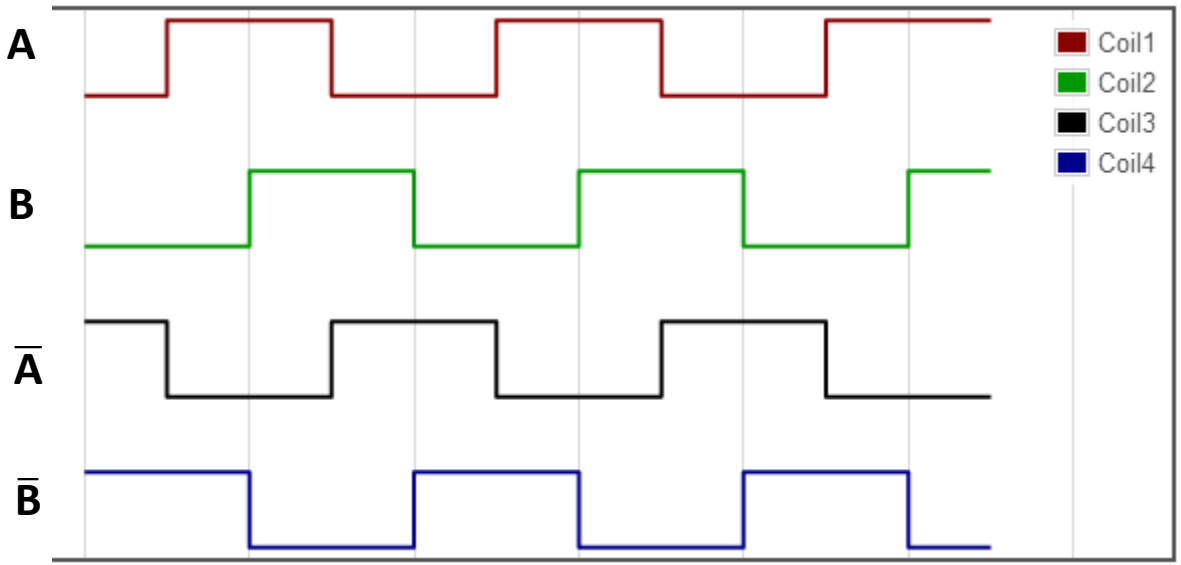
Sens direct

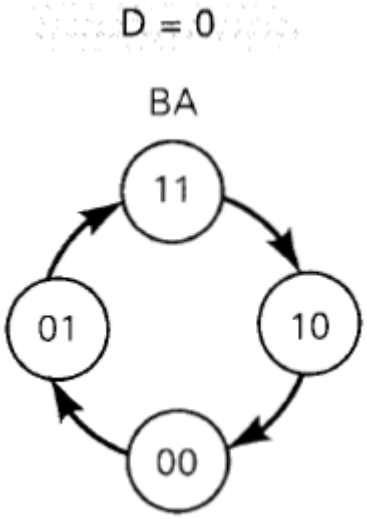




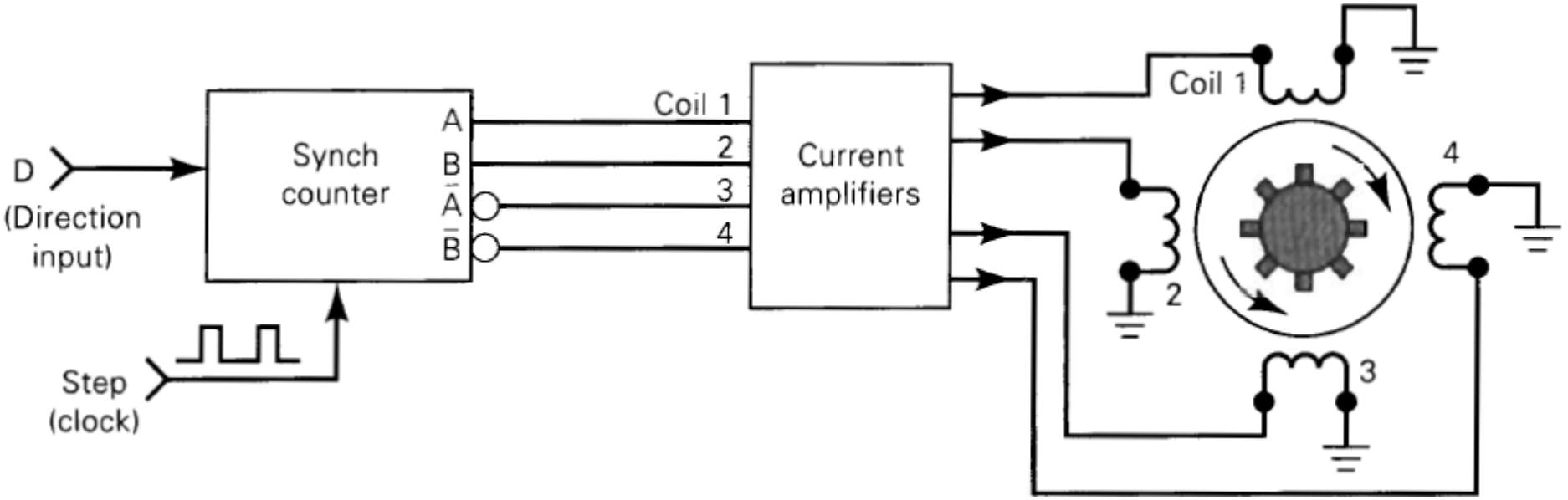
Sens invers

Comanda unui motor pas cu pas (Stepper motor) 4





Sens direct

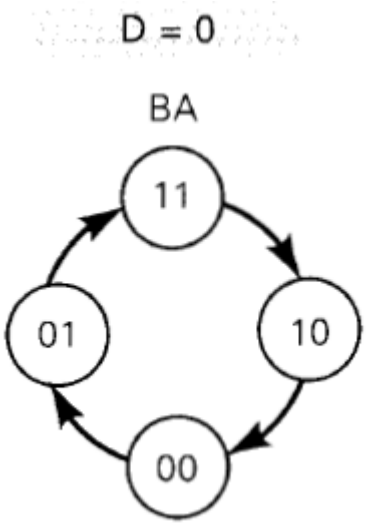


Comanda unui motor pas cu pas (Stepper motor) 5

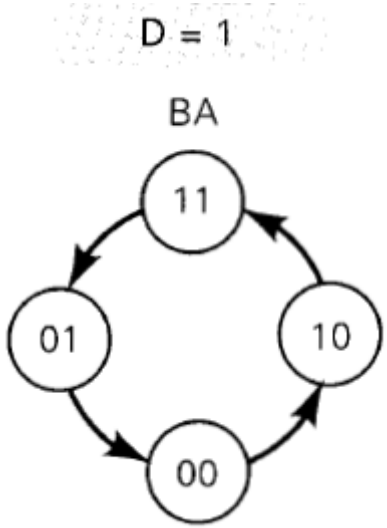
PRESENT State			NEXT State						
D	B	A	D	B	A	J_B	K_B	J_A	K_A
0	0	0	0	0	1	0	x	1	x
0	0	1	0	1	1	1	x	x	0
0	1	0	0	0	0	x	1	0	x
0	1	1	0	1	0	x	0	x	1
1	0	0	1	1	0	1	x	0	x
1	0	1	1	0	0	0	x	x	1
1	1	0	1	1	1	x	0	1	x
1	1	1	1	0	1	x	1	x	0

Excitation table

Q	Q_{next}	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1	1	X	0

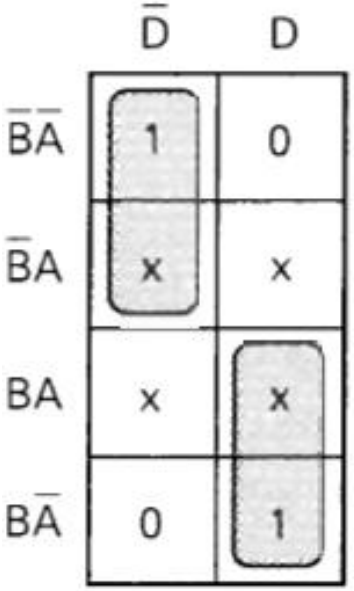


Sens direct

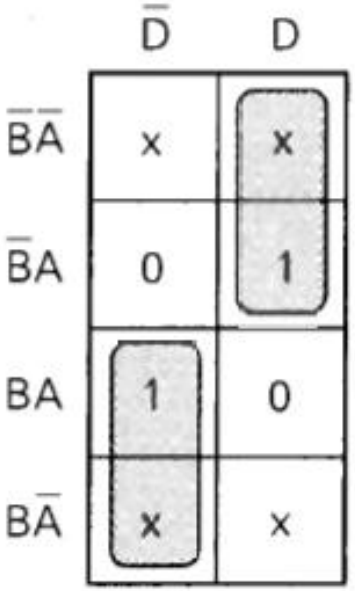


Sens invers

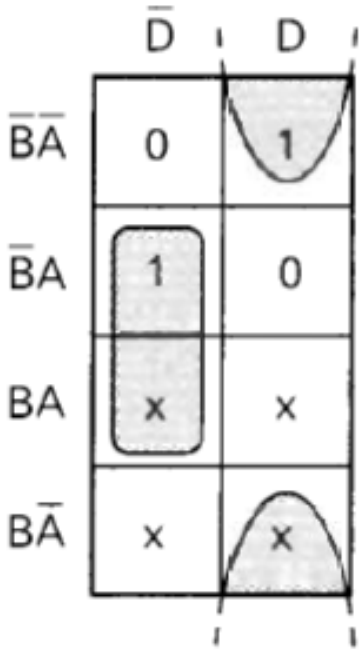
Comanda unui motor pas cu pas (Stepper motor) 6



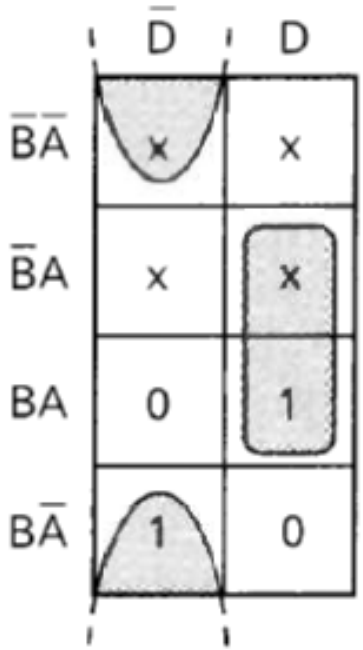
$J_A = \bar{D}\bar{B} + DB$
$= \overline{D \oplus B}$



$K_A = \bar{D}B + D\bar{B}$
$= D \oplus B$

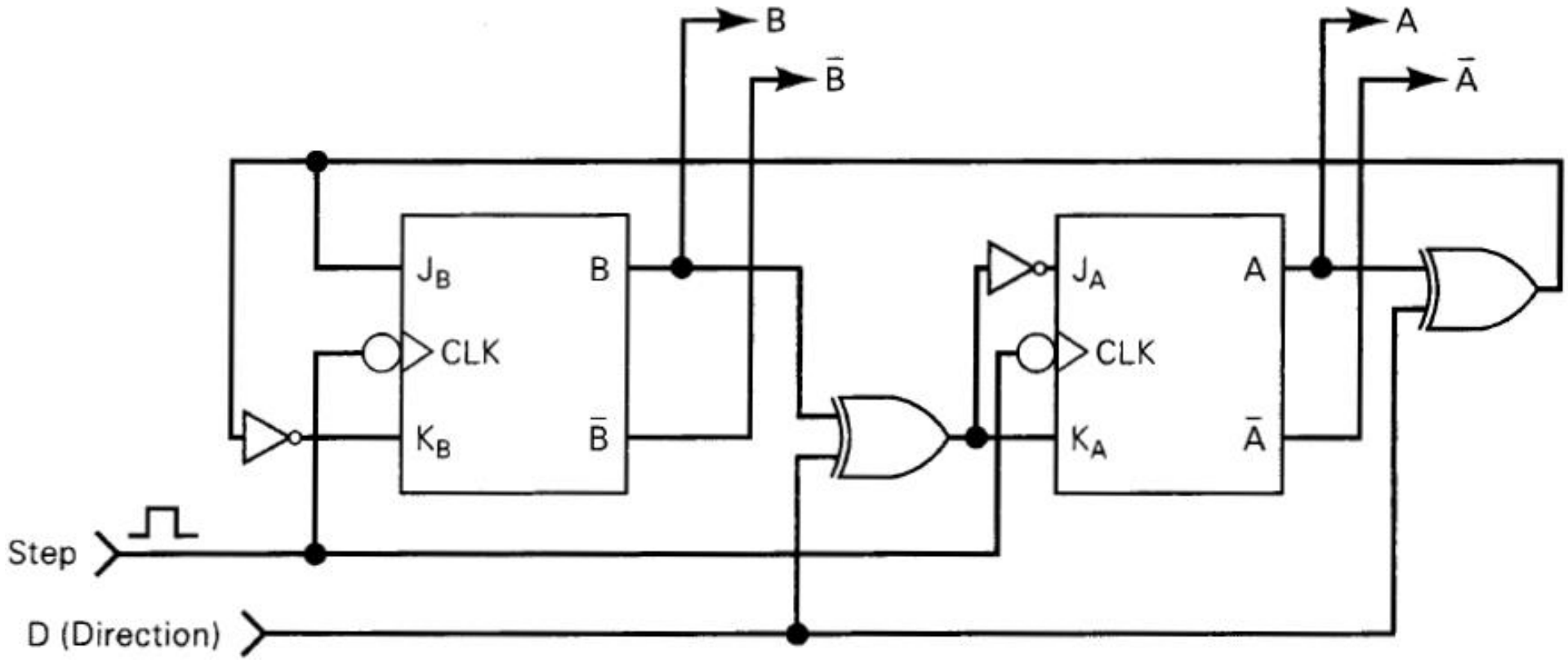


$J_B = \bar{D}A + D\bar{A}$
$= D \oplus A$



$K_B = \bar{D}\bar{A} + DA$
$= \overline{D \oplus A}$

Comanda unui motor pas cu pas (Stepper motor) 7



Multumesc pentru atentie