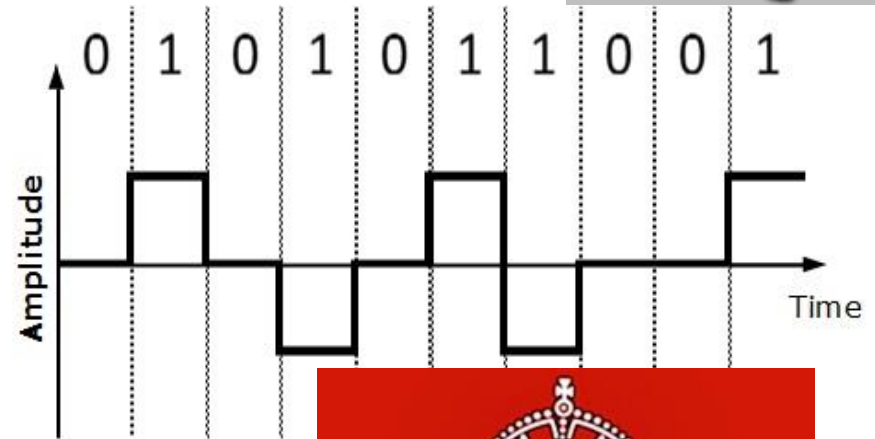
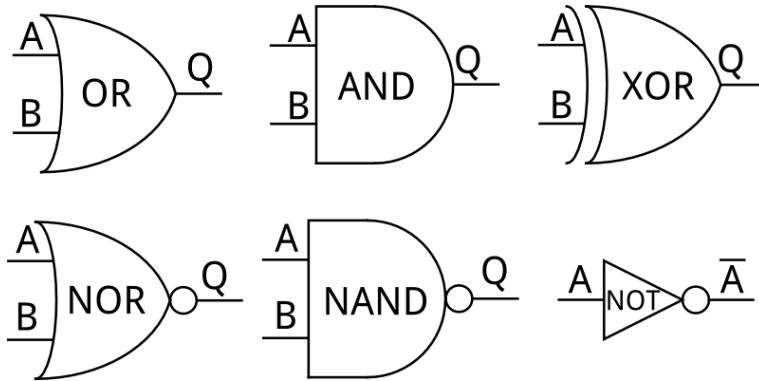


Proiectare Logica

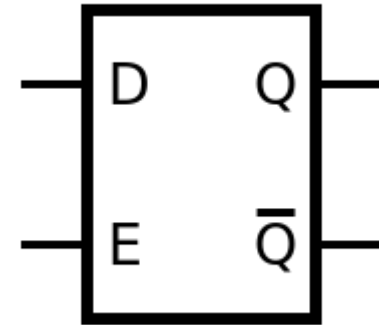
Digital Logic Design

Curs 09

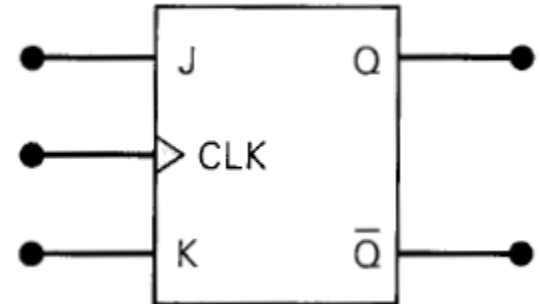


Recapitulare Curs 07

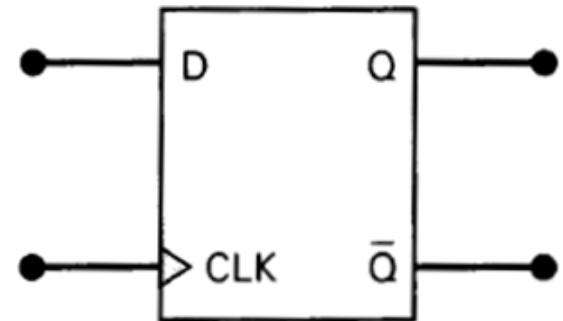
Transparent LATCH



Bistabilul JK

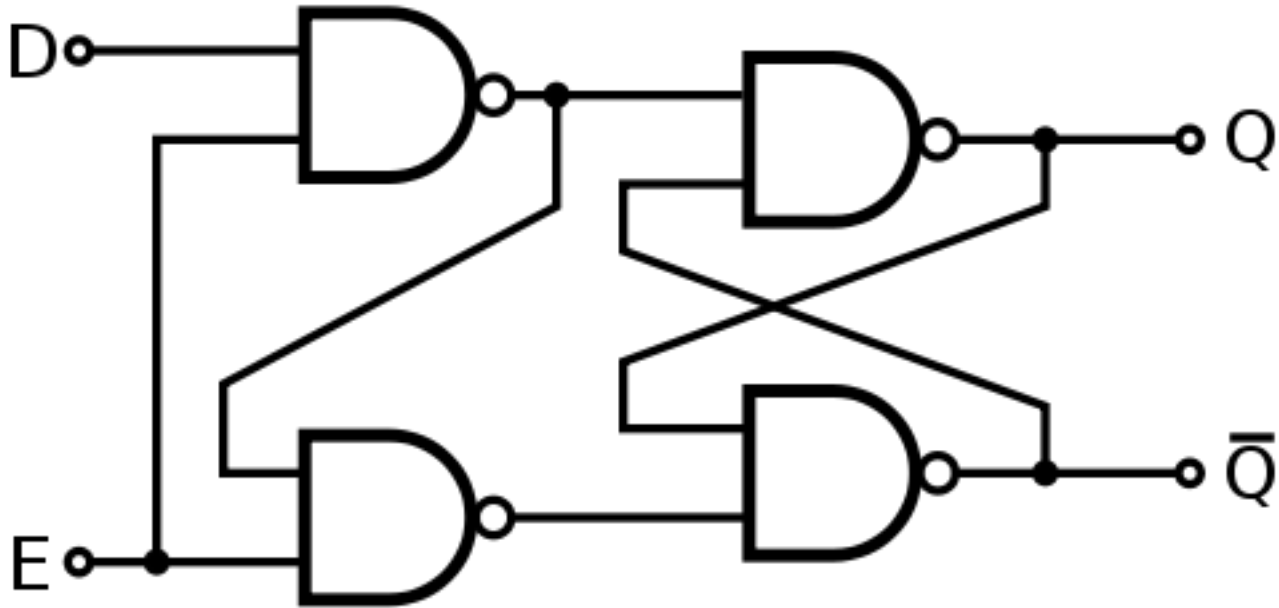


Bistabilul de tip D

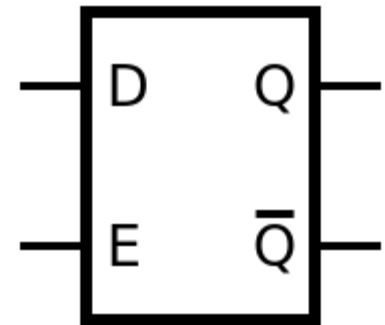


Gated D latch based on SR NAND

Transparent LATCH

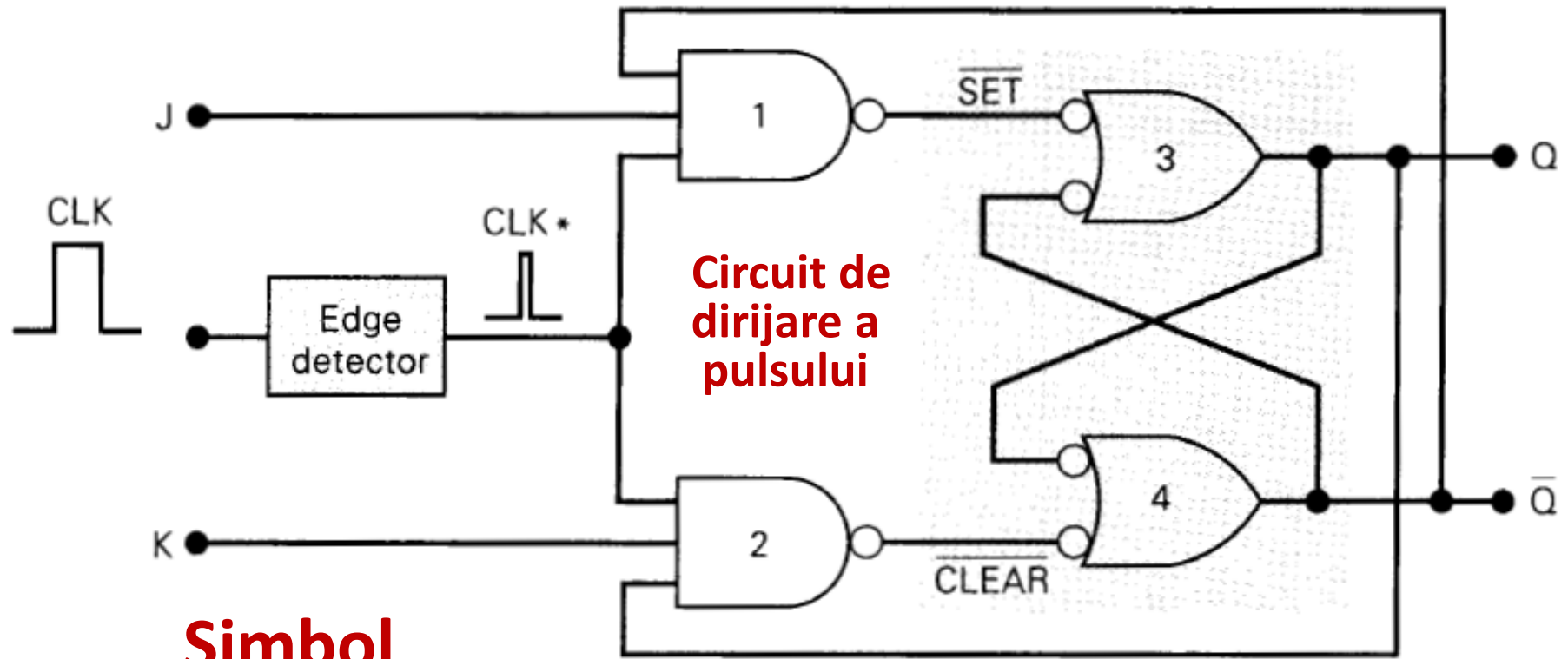


E/C	D	Q	Q'	Comment
0	X	Q_{ant}	$!Q_{ant}$	Mem
1	0	0	1	Reset
1	1	1	0	Set

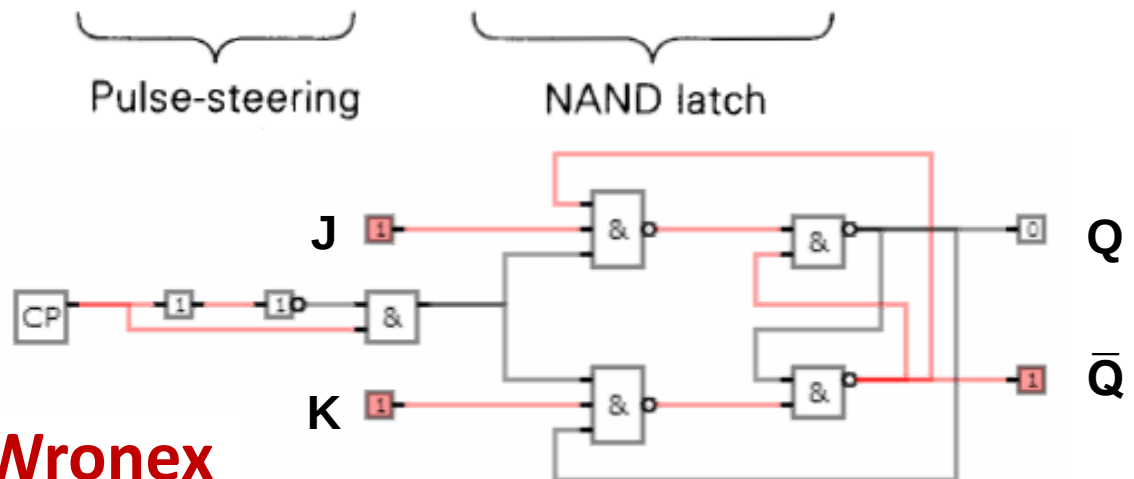
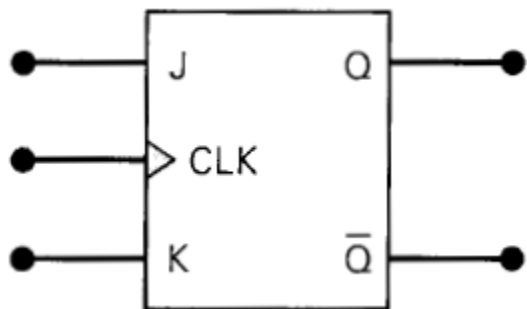


Tema: **De simulat in Wronex**

Bistabilul JK: schema interna

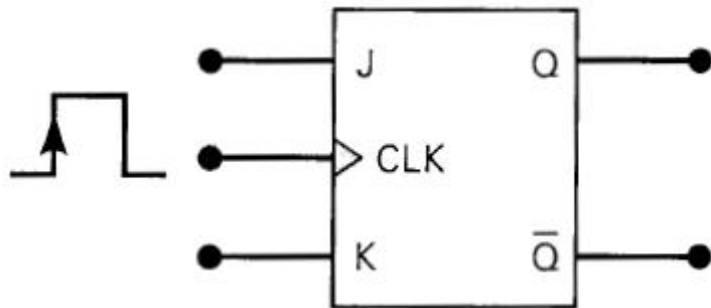


Simbol

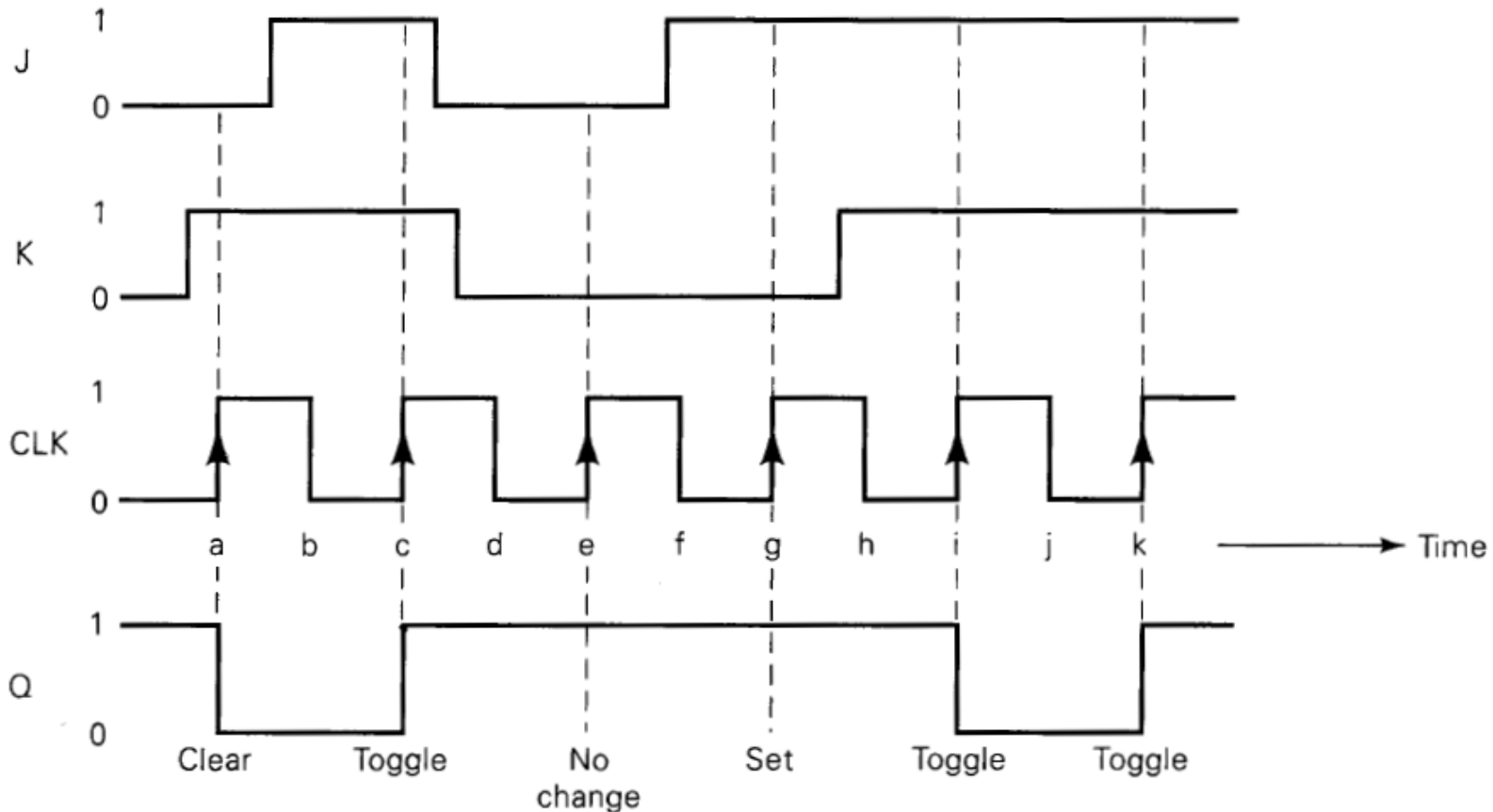


Tema: De simulat in Wronex

Bistabilul JK: tranzitie pe frontul pozitiv

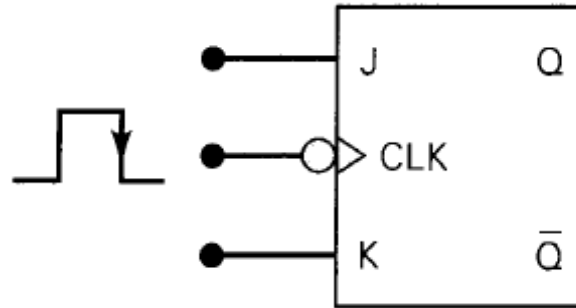


J	K	CLK	Q
0	0	↑	Q_0 (no change)
1	0	↑	1
0	1	↑	0
1	1	↑	$\overline{Q_0}$ (toggles)

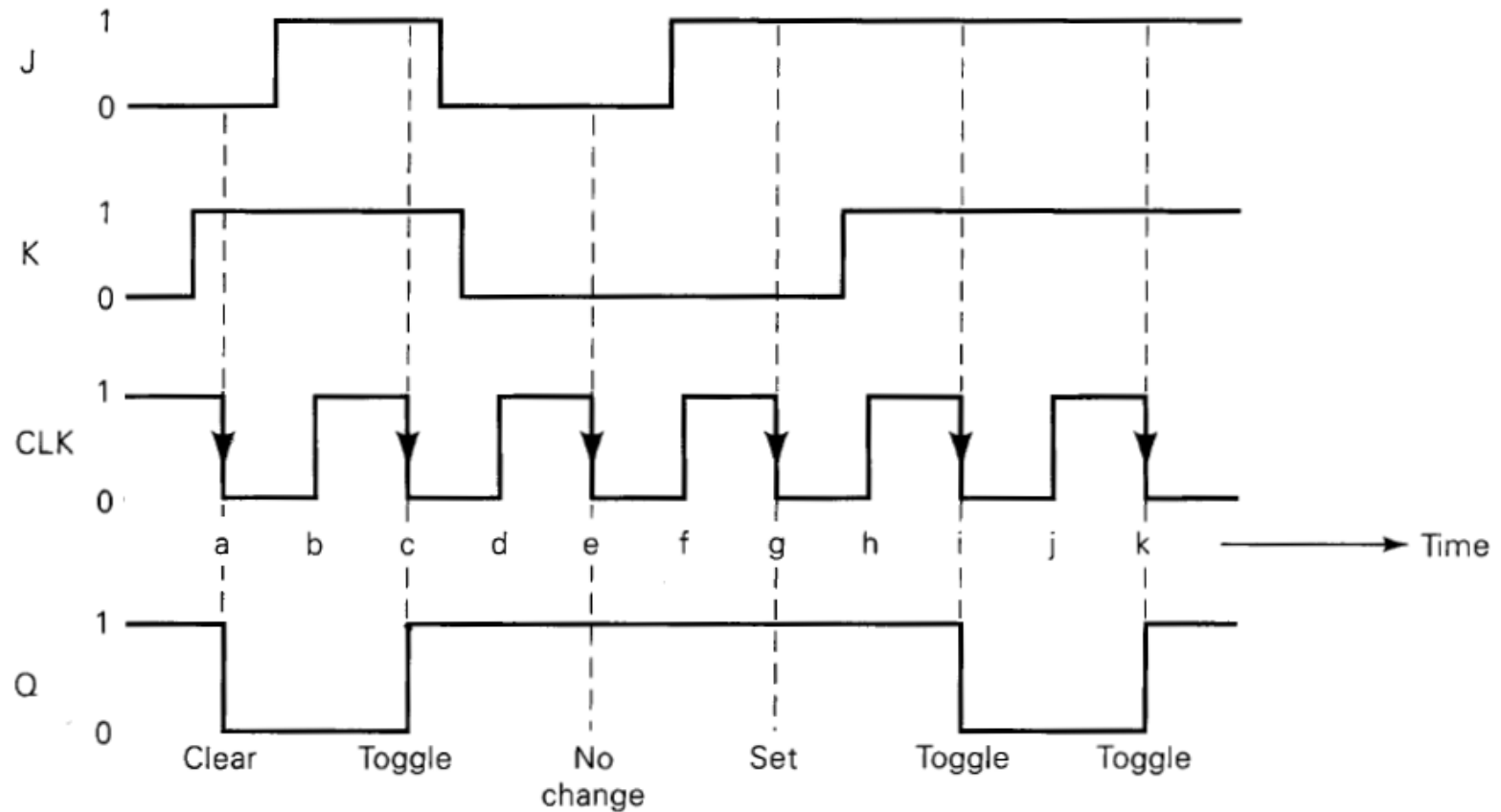


Bistabilul JK: tranzitie pe frontul negativ*

6

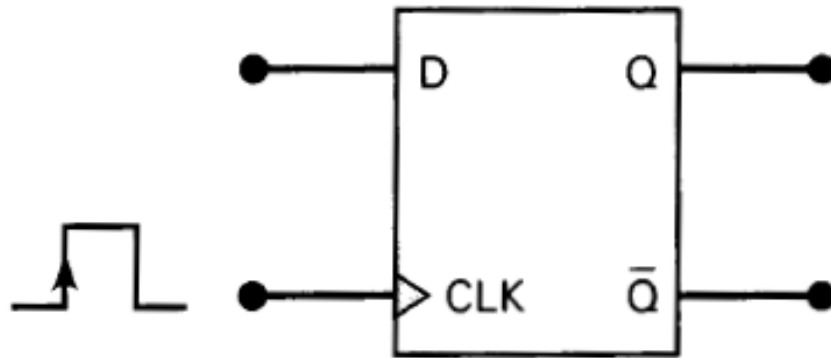


J	K	CLK	Q
0	0	↓	Q_0 (no change)
1	0	↓	1
0	1	↓	0
1	1	↓	$\bar{Q}_0$ (toggles)



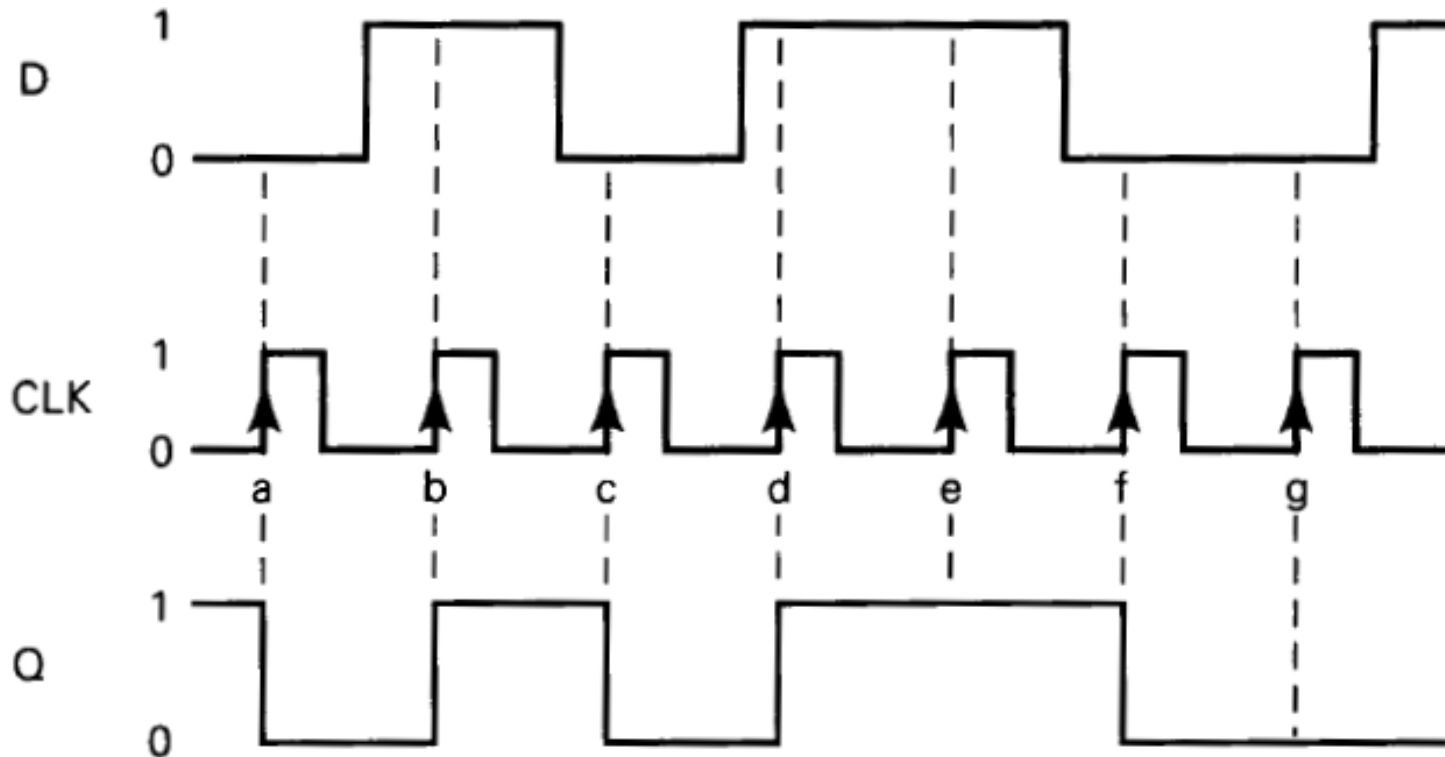
Bistabilul de tip D: *Clocked D Flip-Flop*

7



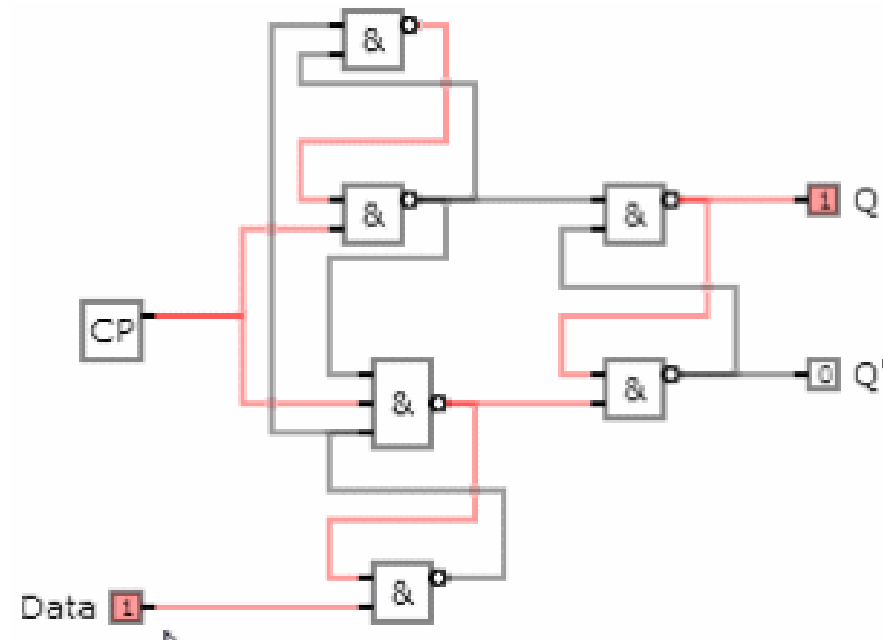
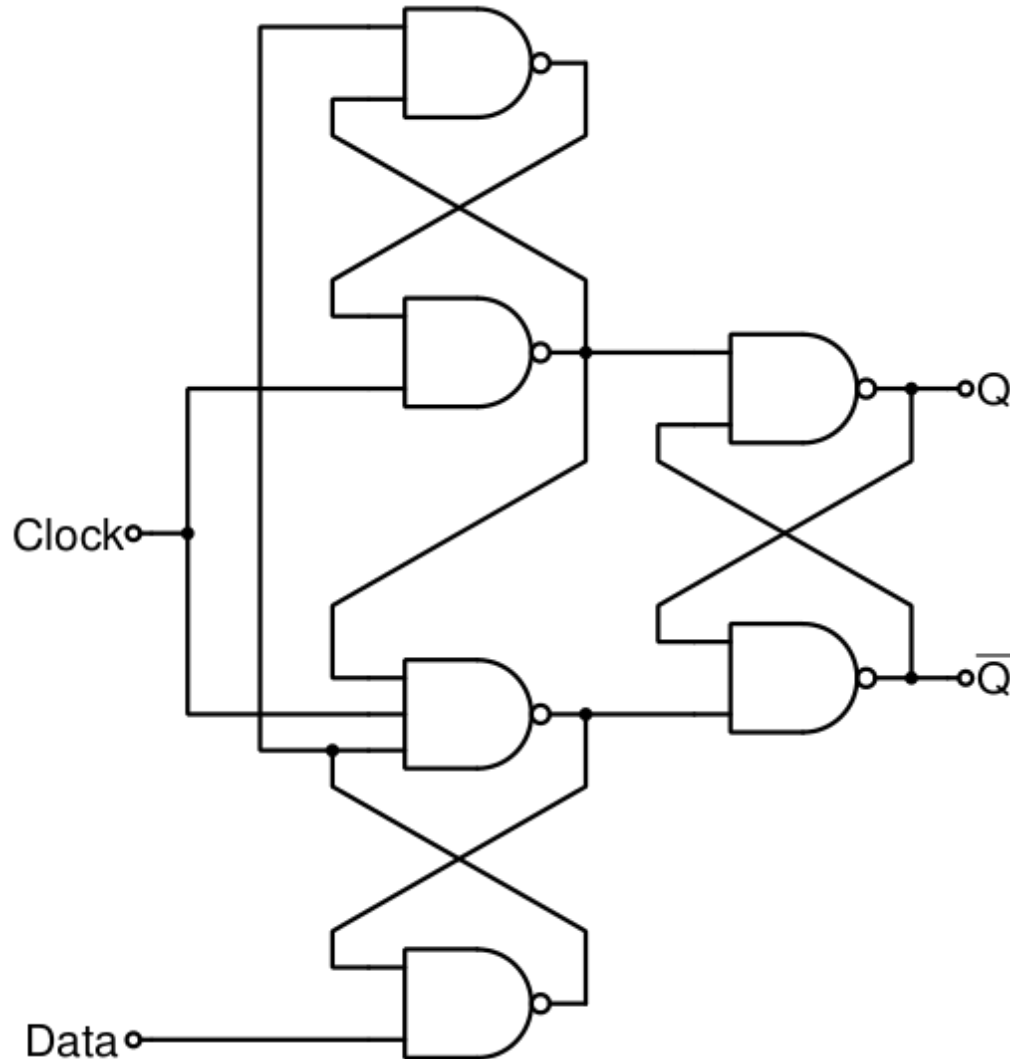
(a)

D	CLK	Q
0	↑	0
1	↑	1



Bistabilul de tip D: schema interna

Tema: **De simulat in Wronex**



NUMARATOARE

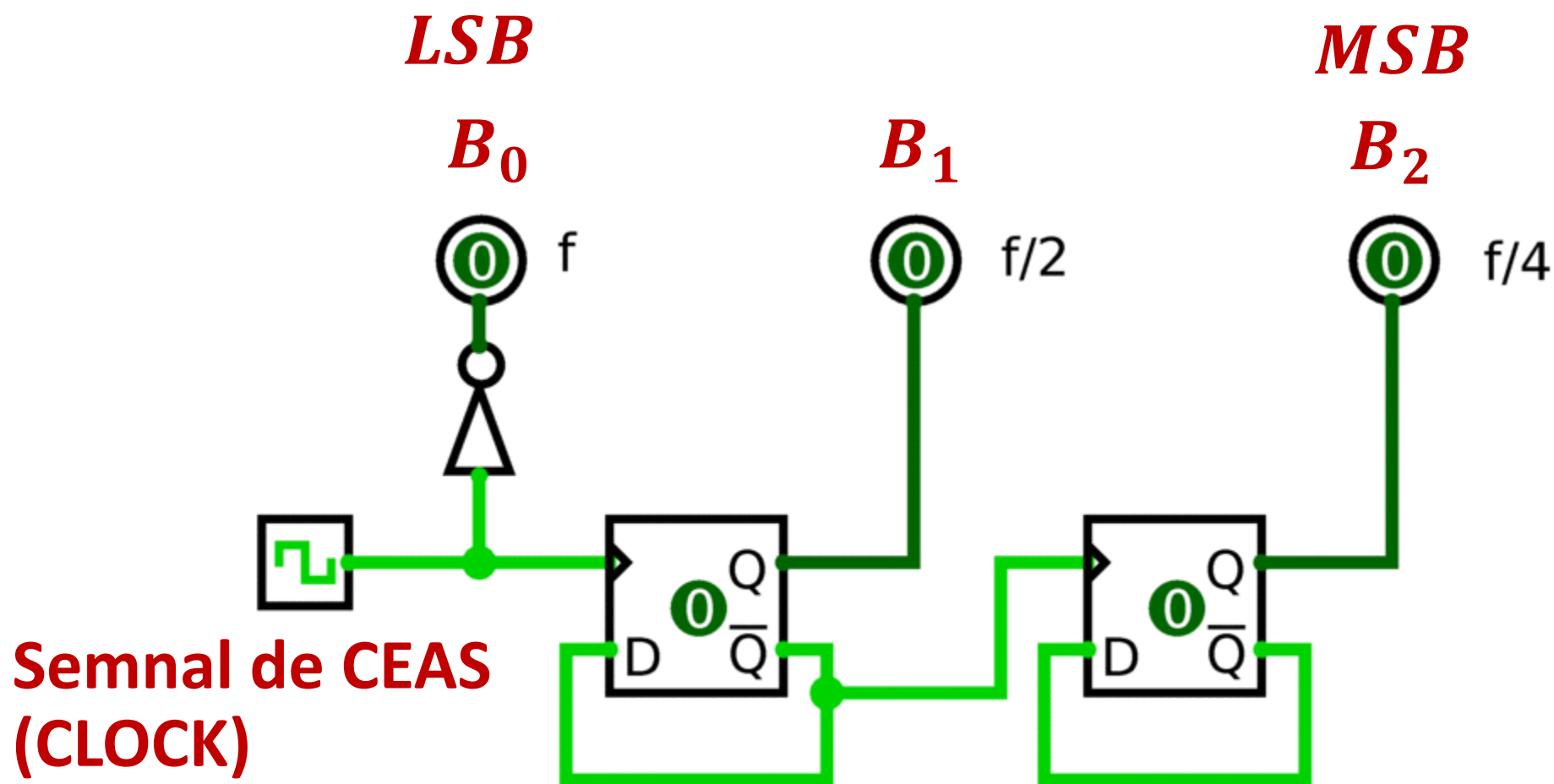
Counters

- **UP/DOWN**
- **synchronous / asynchronous**



Aplicatii bistabili: Divizarea frecventei

- Numarator binar crescator
- Numarator MOD 8
- Numarator Asincron



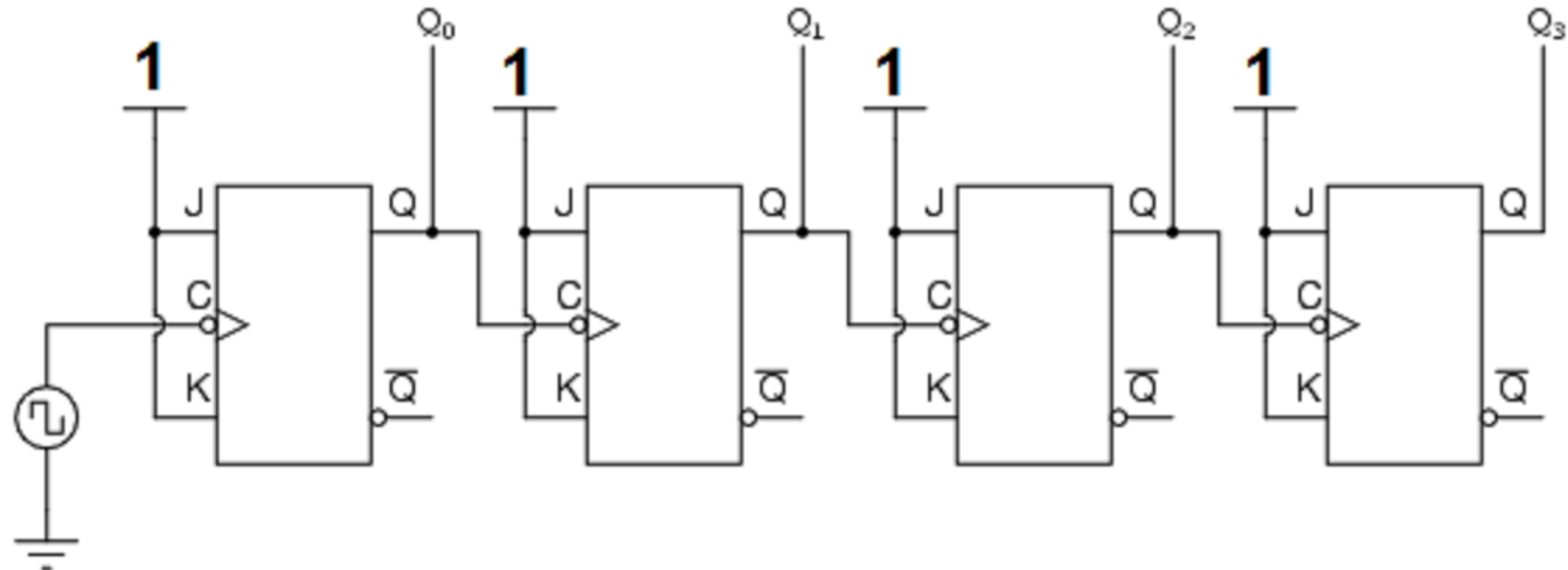
Ce face schema urmatoare?

TEMA:

Simulati in wronex
aceasta schema!

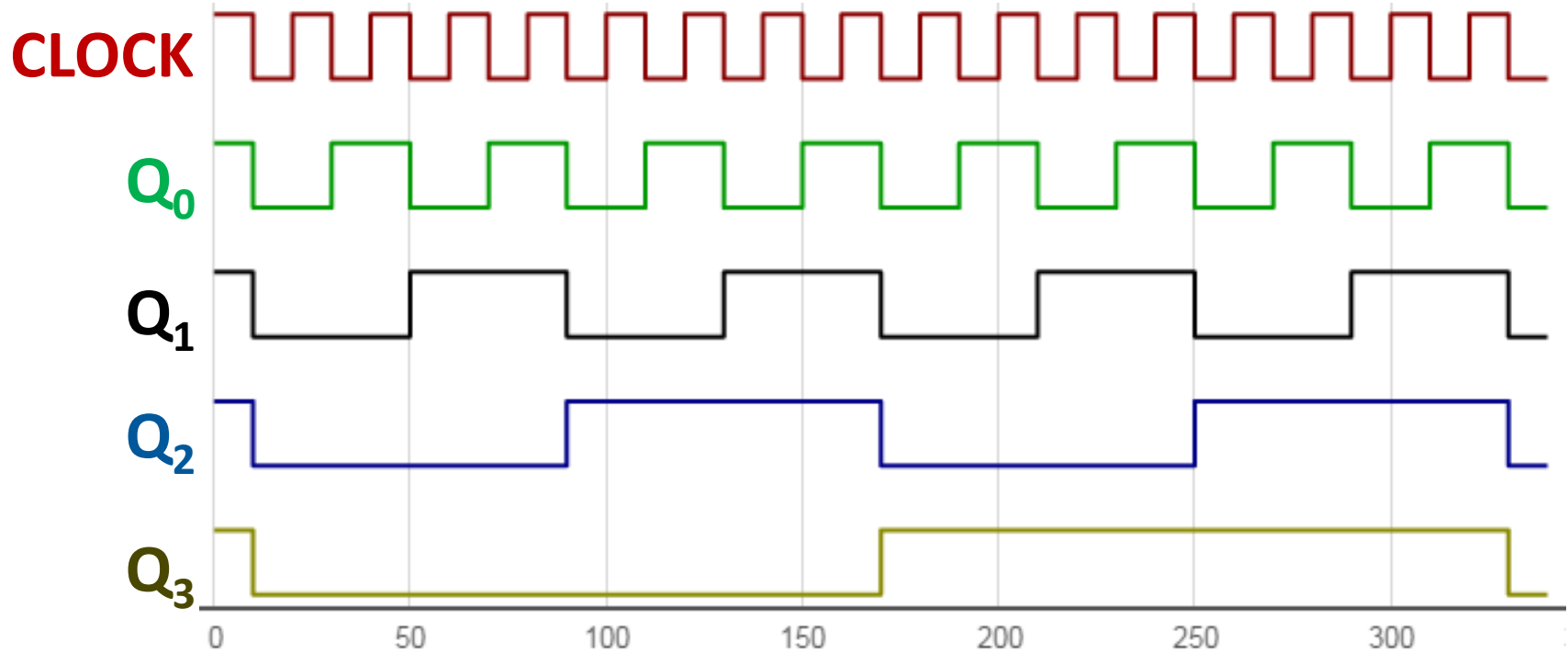
Desenati diagrama
temporala folosind
[aceasta](#) pagina.

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



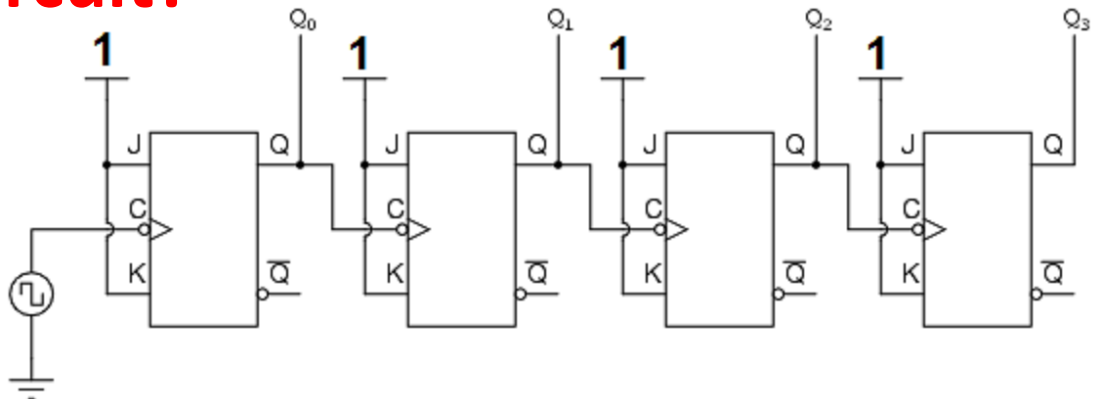
Ce face schema urmatoare?

Diagrama temporală CORECTĂ este:



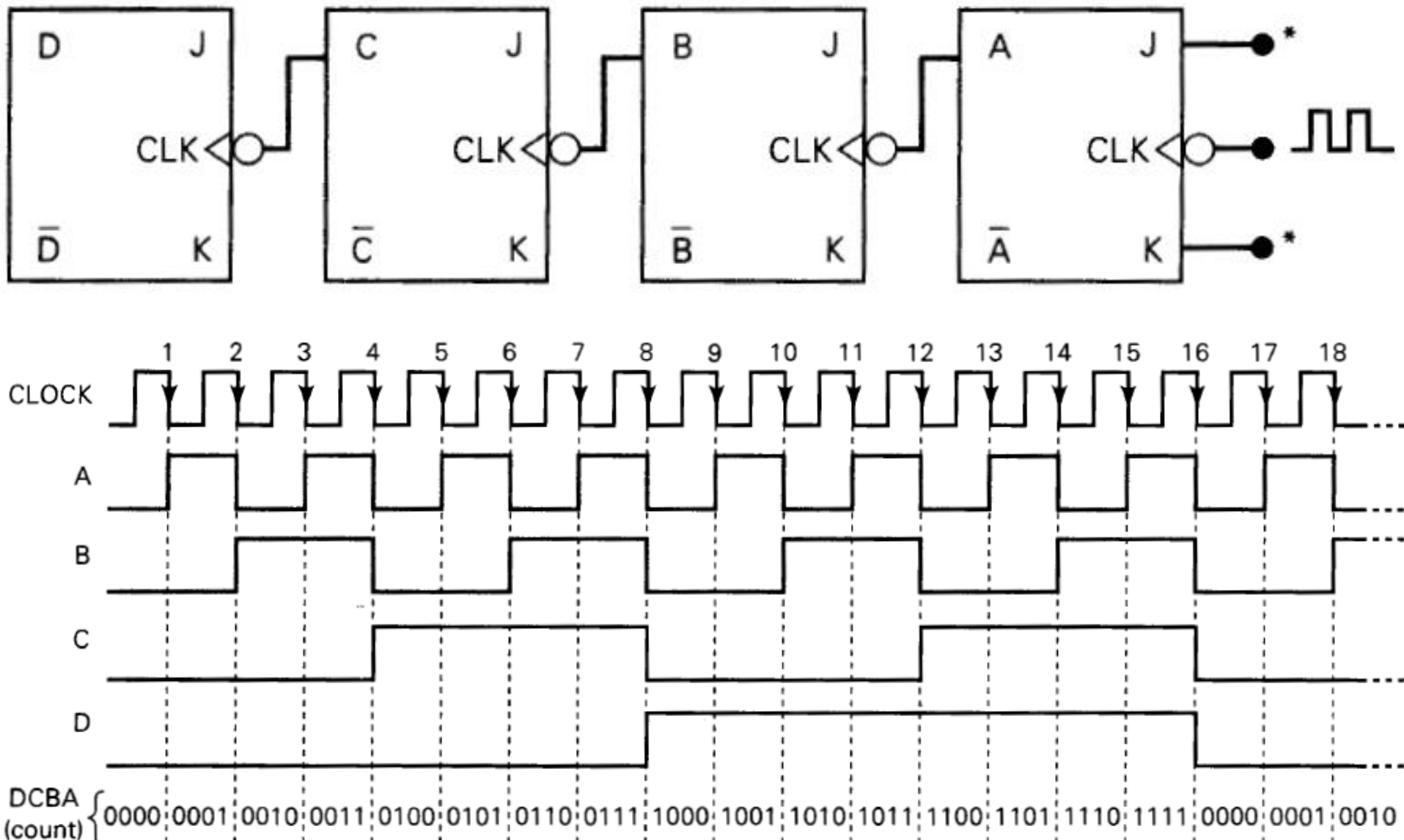
Cum numara acest circuit?

UP/DOWN?



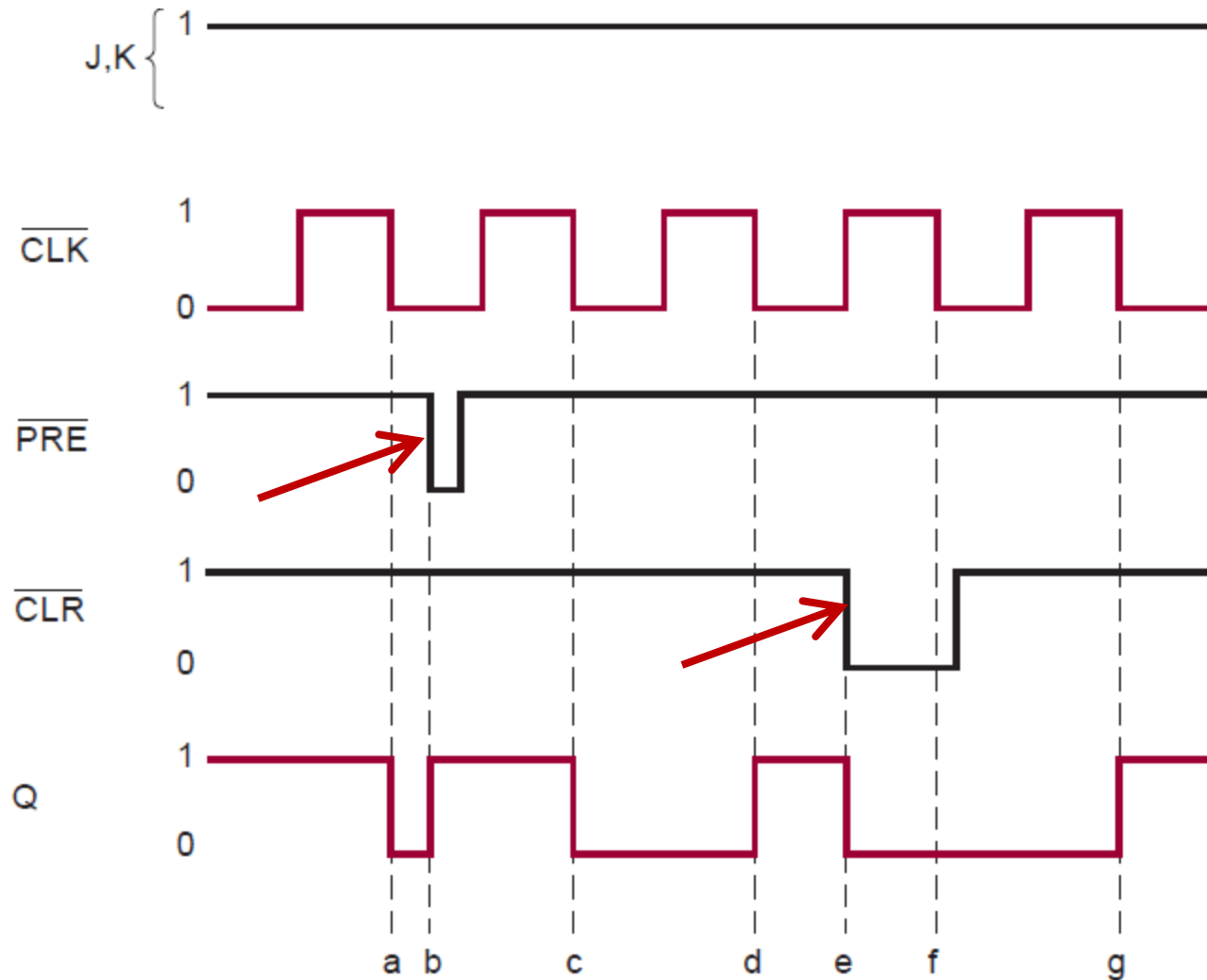
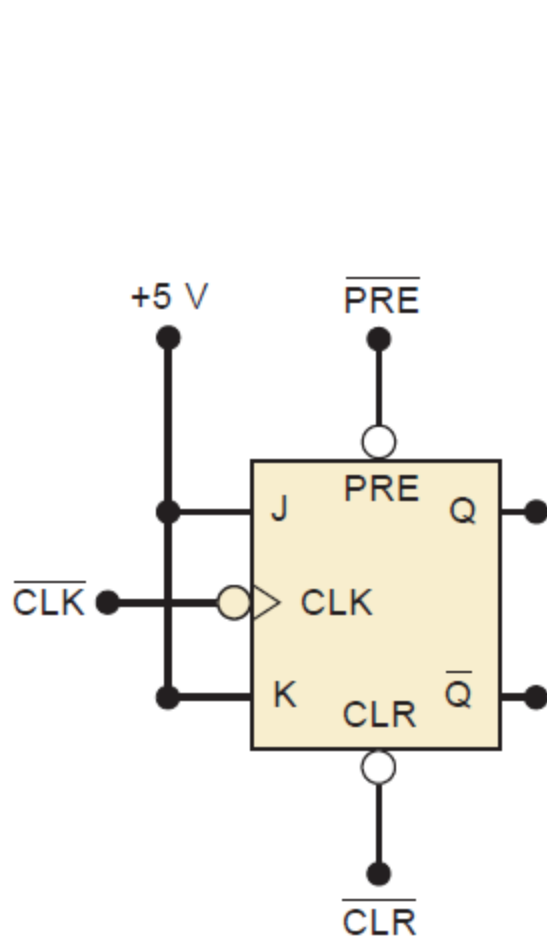
Numarator asincron (ripple counter)

- J si K sunt in 1



Intrari asincrone ale bistabilelor JK

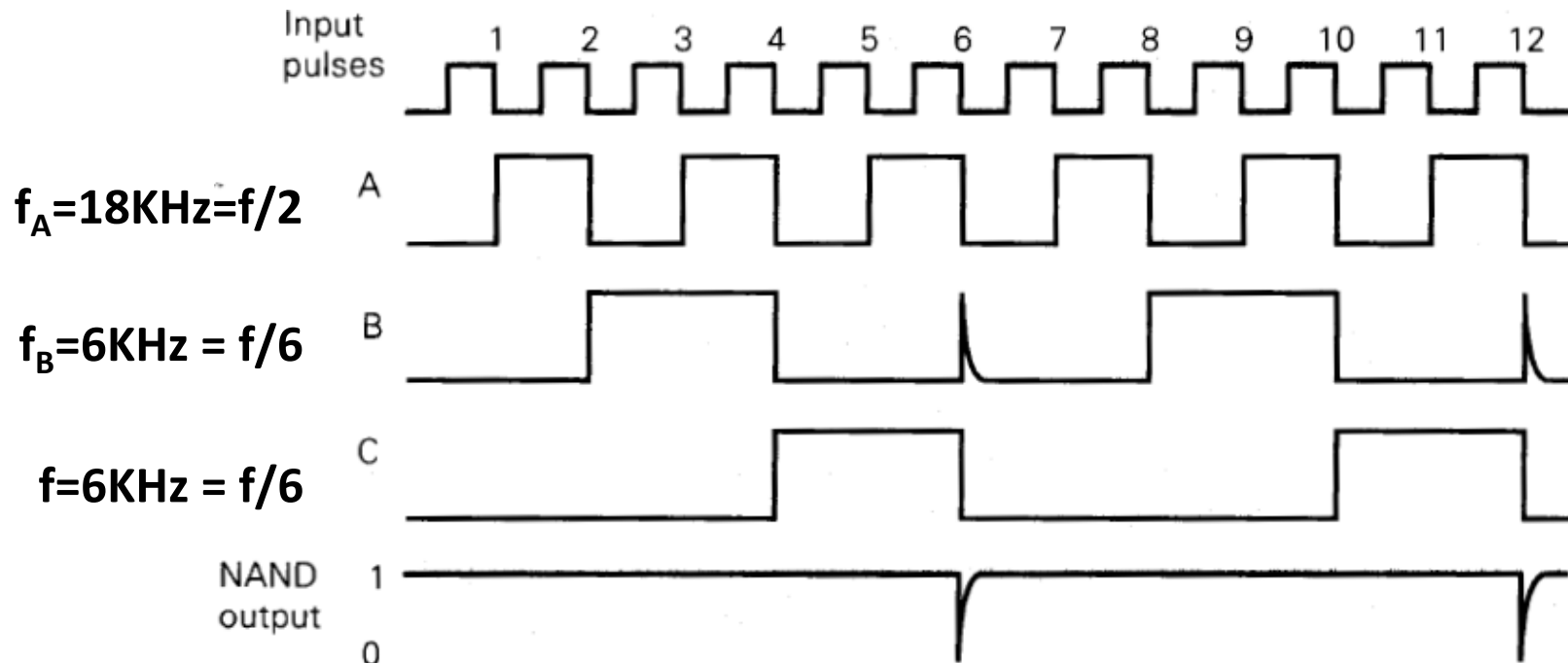
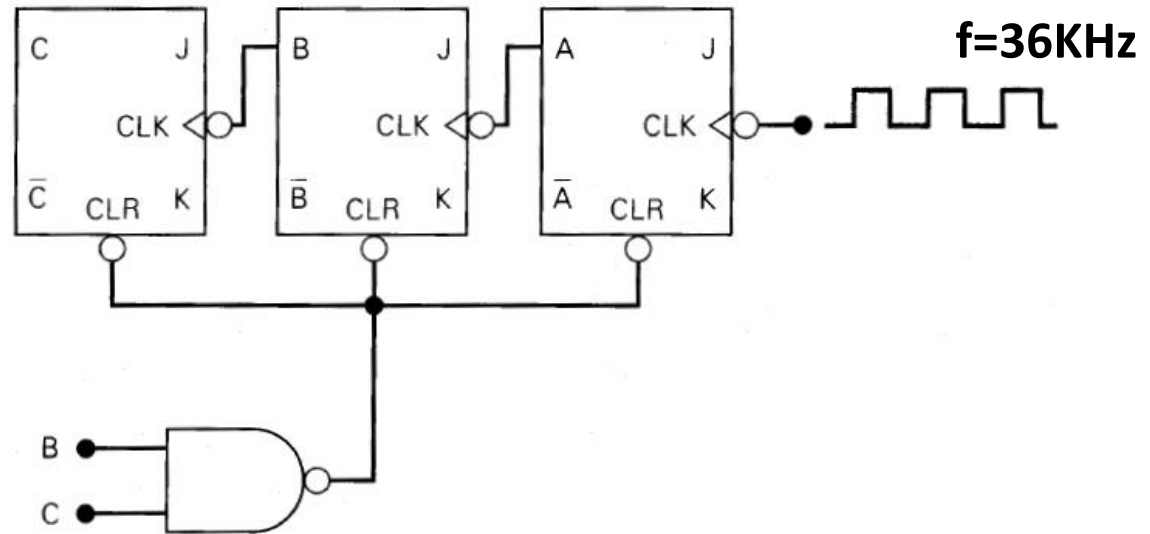
- PRESET (S) si CLEAR (R)



b si e → tranzitii asincrone

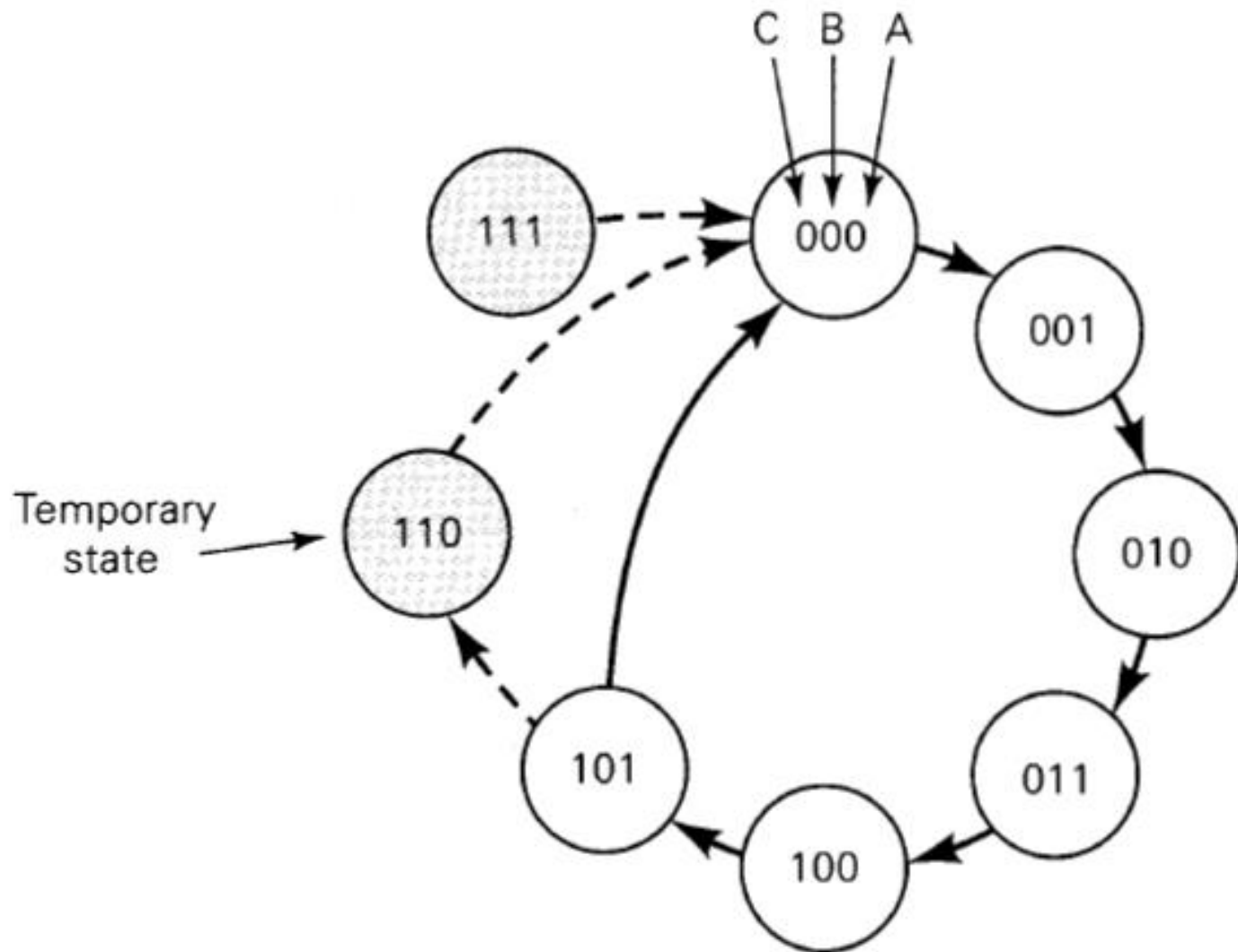
Numarator modulo 6

- J si K sunt in 1



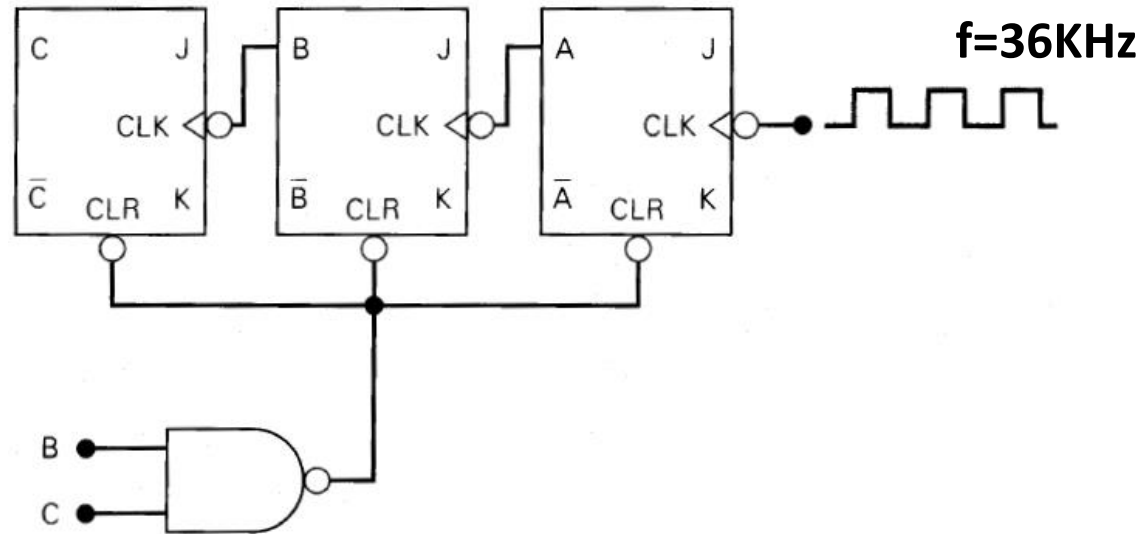
Numarator modulo 6 diagrama stari

- Un numarator modulo n se face prin fortarea trecerii din starea n in starea 0 .

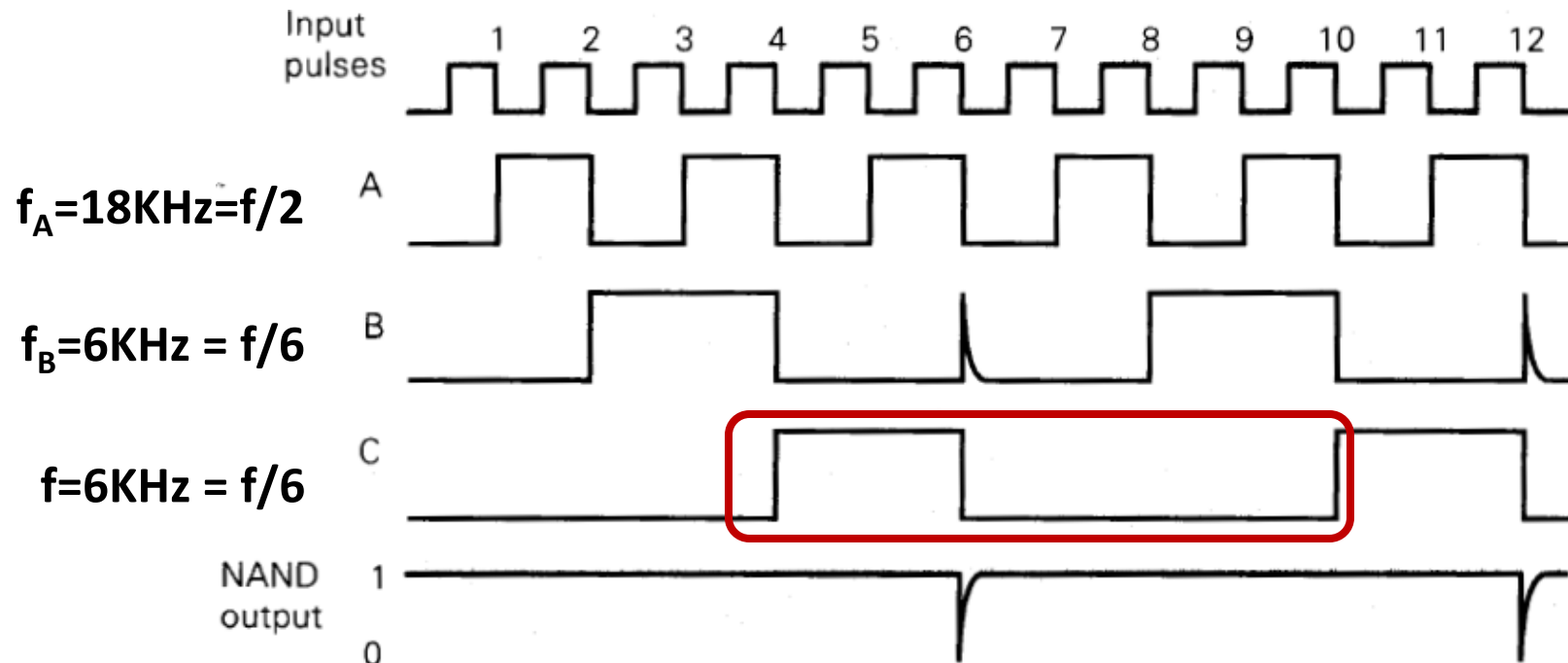


Numarator MOD6: factor de umplere 1/3

- J si K sunt in 1

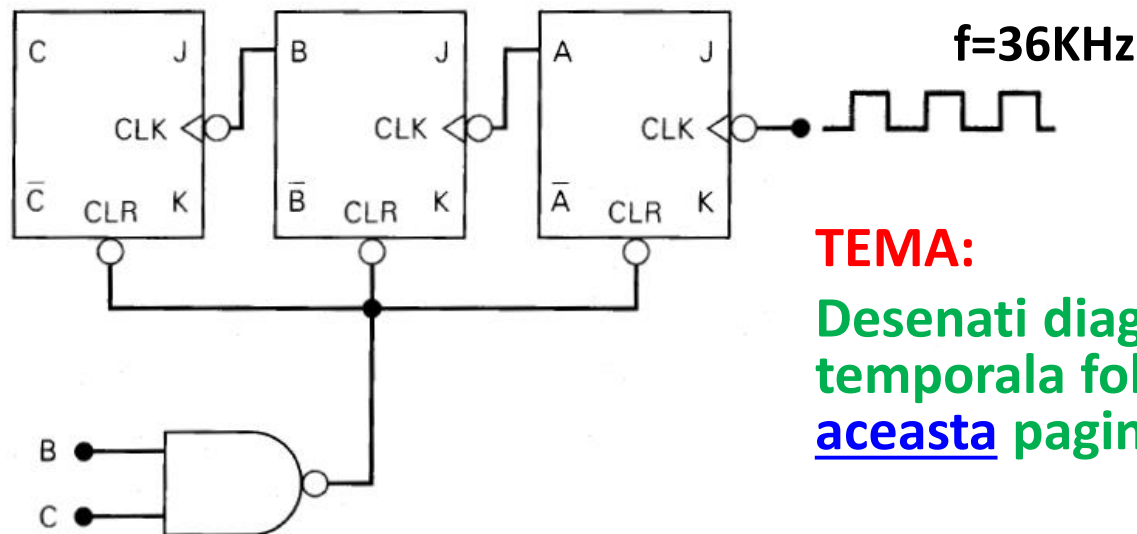


L-AM MAI VAZUT !!!



Numarator MOD6: factor de umplere 1/3

- J si K sunt in 1



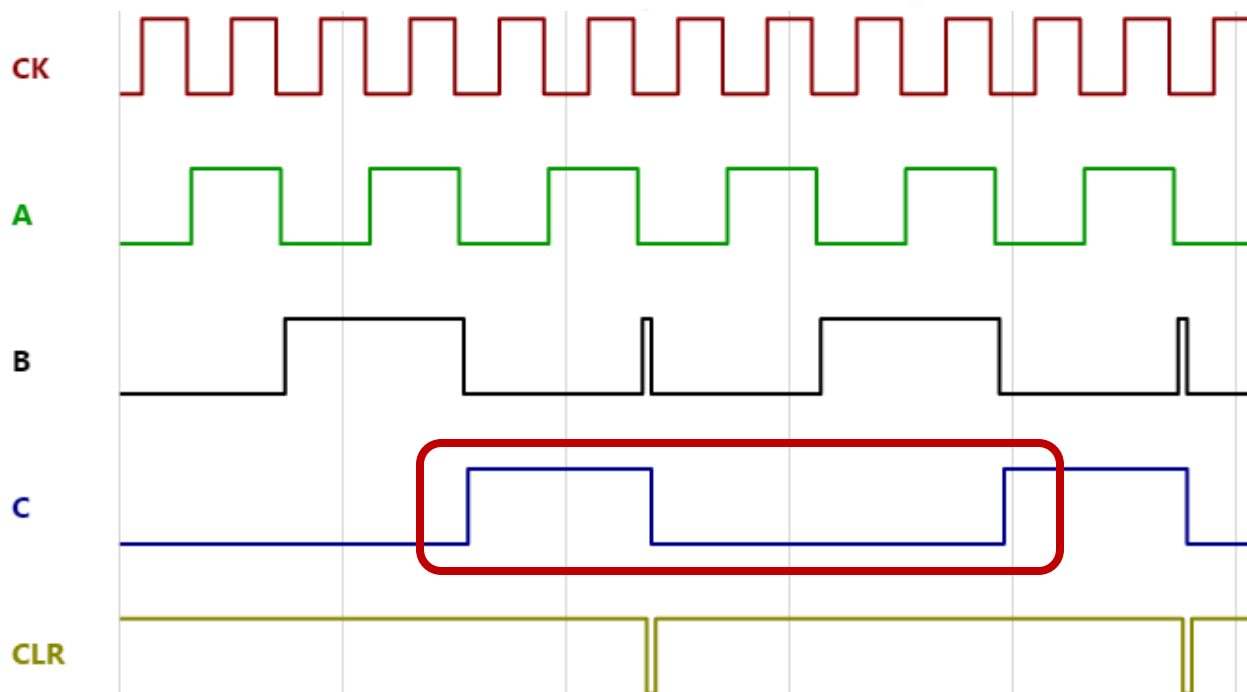
TEMA:

Desenati diagrama
temporala folosind
[aceasta](#) pagina.

$$f_A = 18\text{KHz} = f/2$$

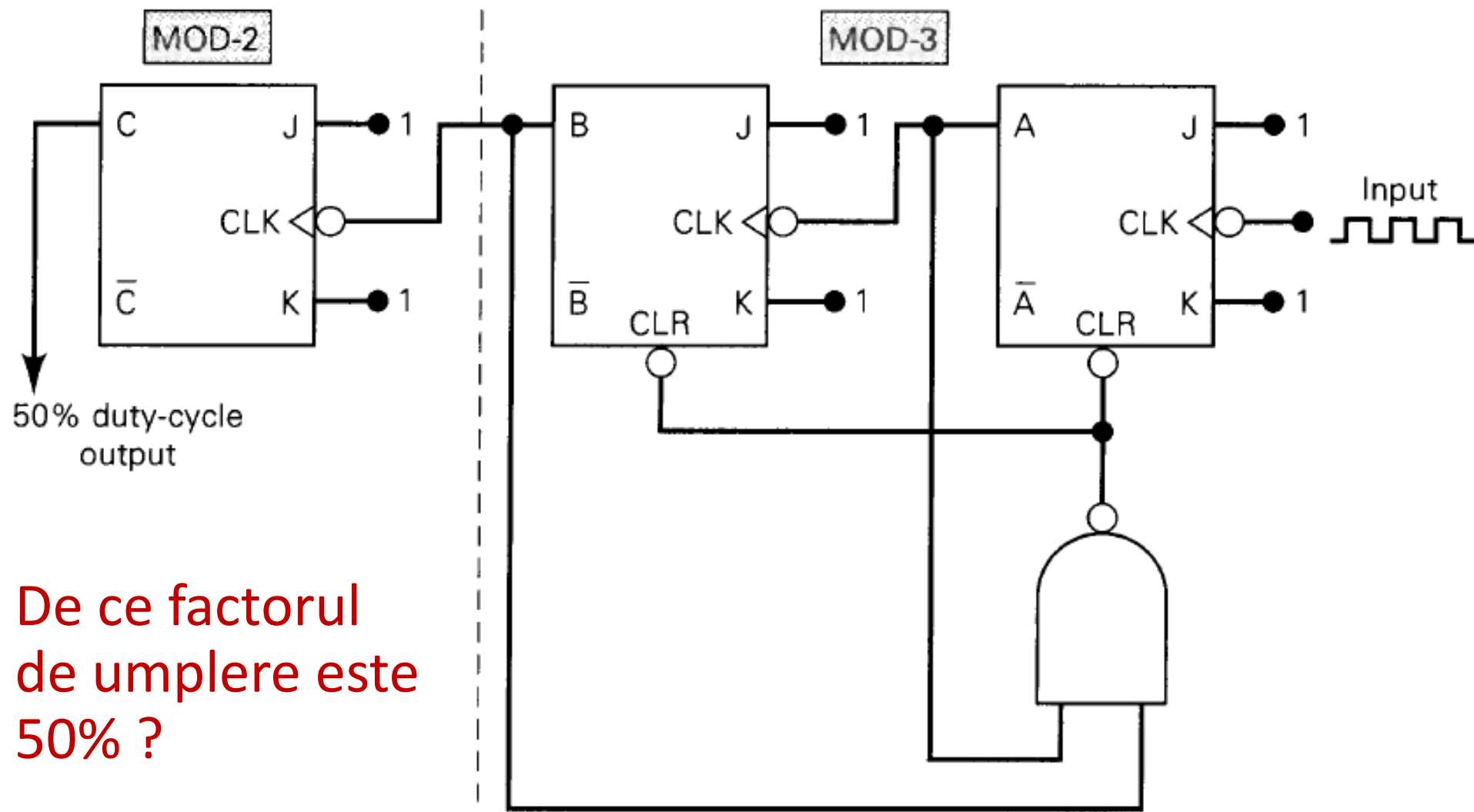
$$f_B = 6\text{KHz} = f/6$$

$$f_C = 6\text{KHz} = f/6$$



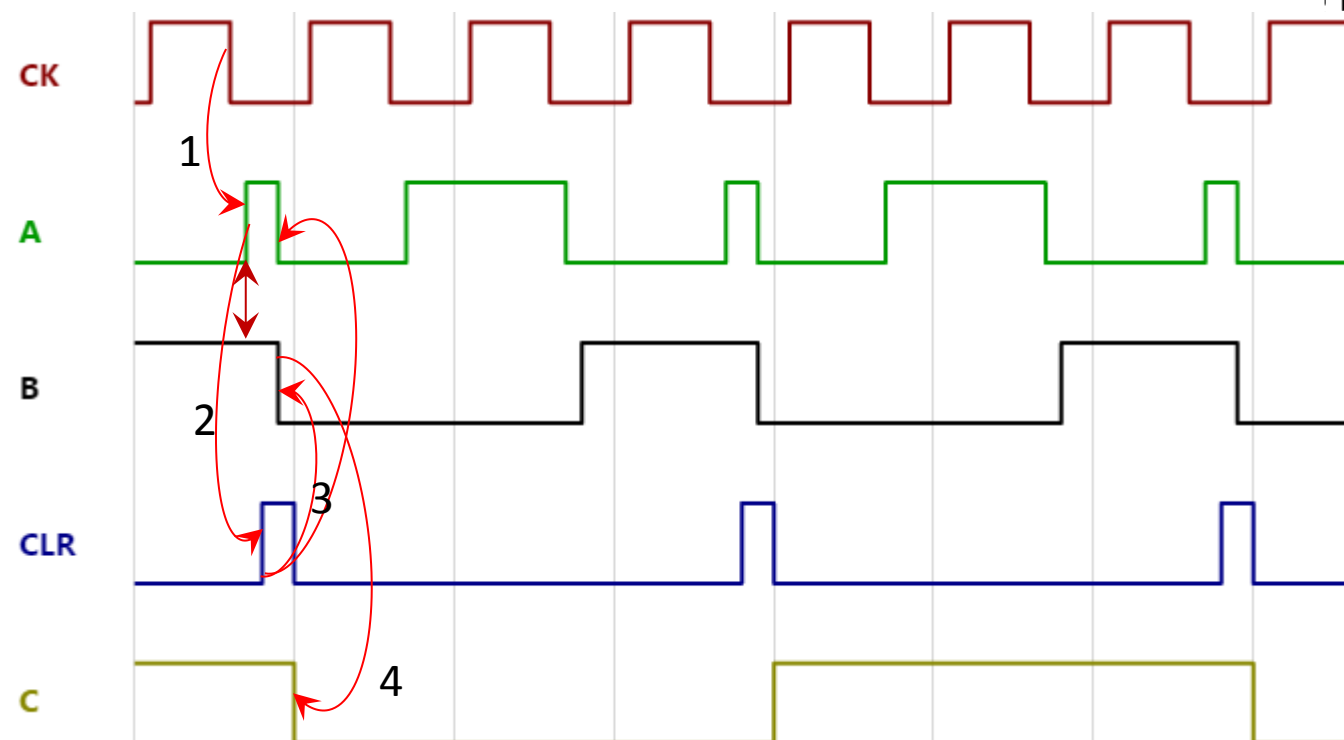
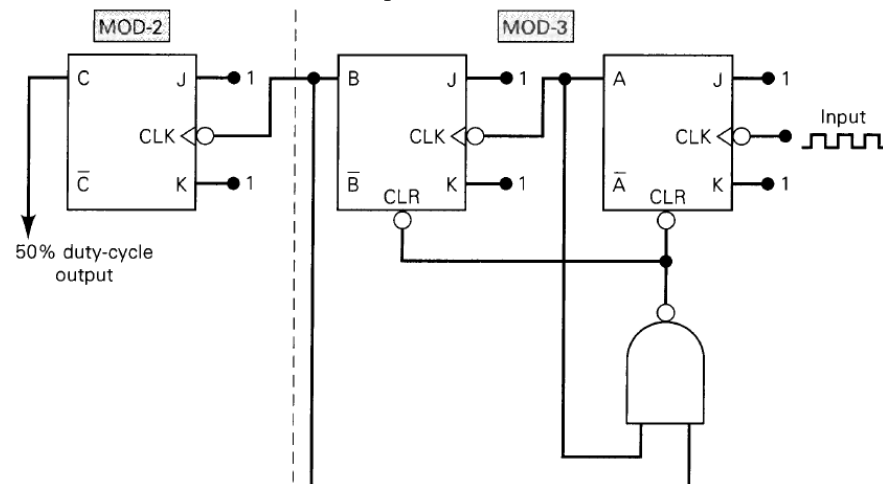
Numarator MOD6 cu factor de umplere %50

Este un numarator sincron?



Numarator MOD6 cu factor de umplere %50

Este un numarator sincron?



De ce factorul de umplere este 50% ?

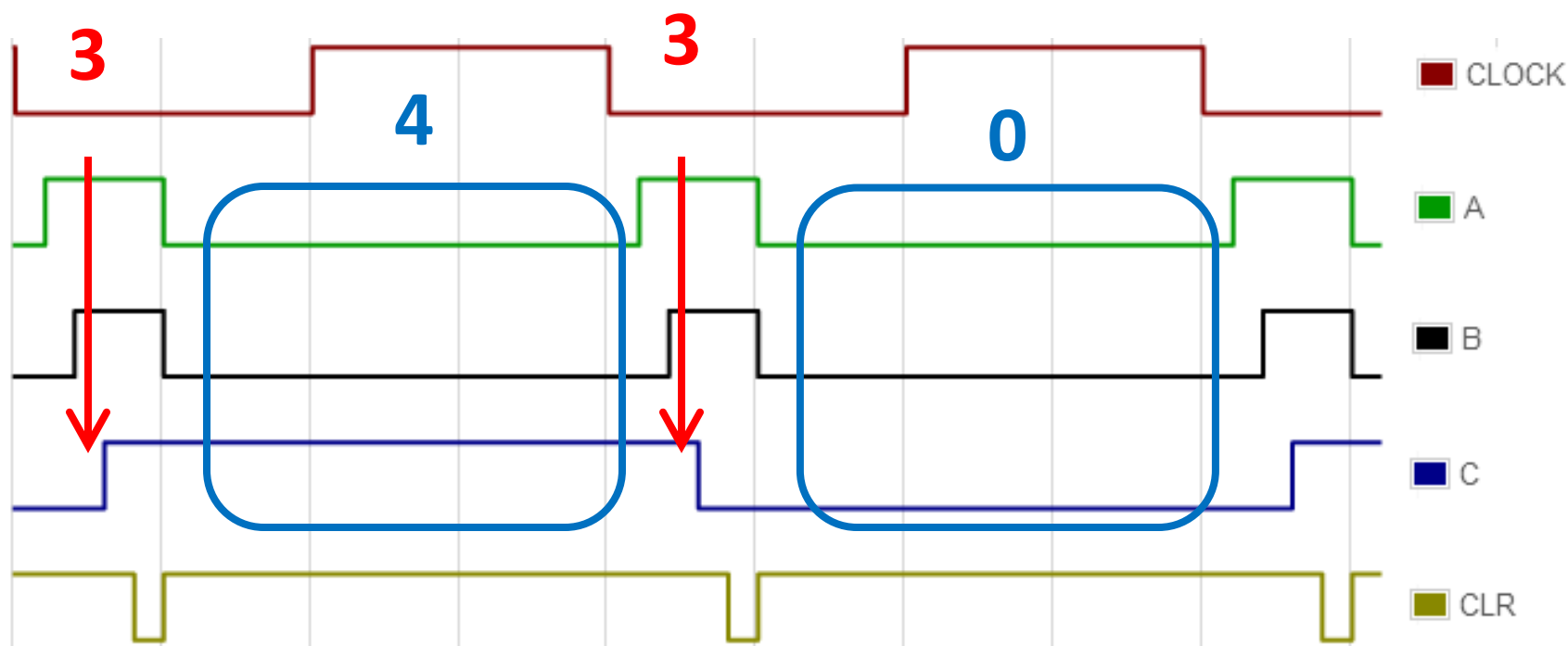
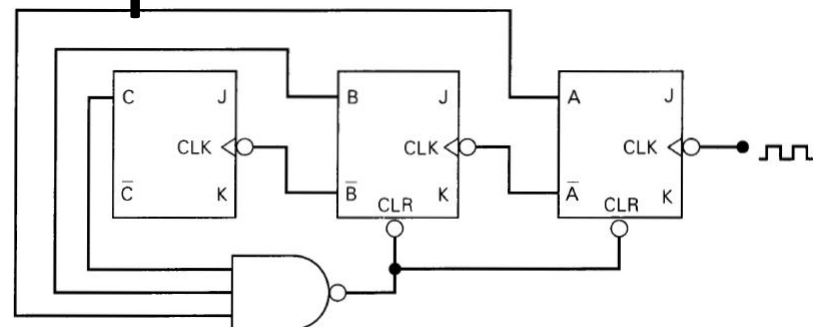
[illegible]

- De ce simularea in Wronex a acestui numarator oscileaza intre 0 si 4?
- In plus se vede pentru scurt timp si starea 3.

Problema 1: Raspuns

TEMA: Desenati diagrama de stari.

Formele de unda sunt:



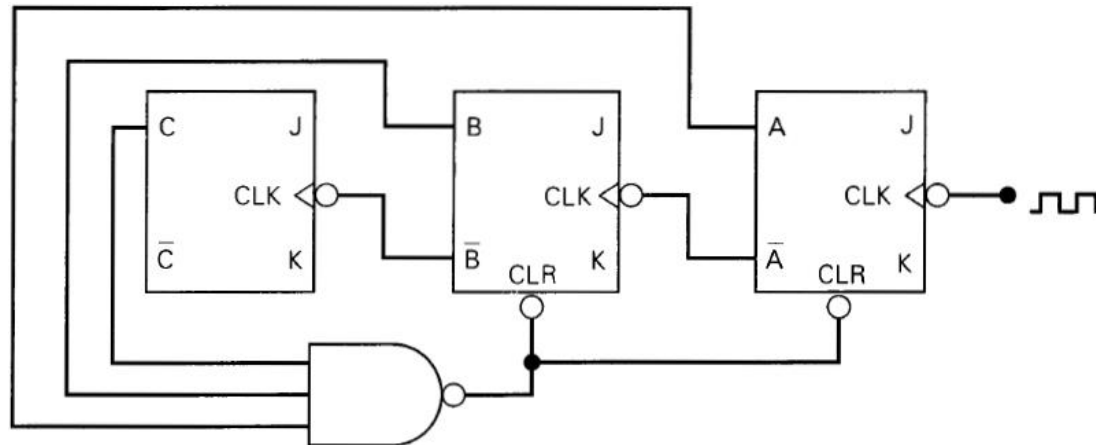
De fapt numparatorul trece prin starile:

0 → 1 → 3 → 7 → 4 → 4 → 4 → 4 → 5 → 7 → 3 → 0 → 0 → 0 → 0 → 0 → 1 → 3 → 7 → 4

Problema 1: Raspuns (2)

Starile din textarea sunt:

10001:0.1	01011:1 → 5
00001:1 → 0	01111:1 → 7
01001:1 → 1	01101:1 → 3
01101:1 → 3	01100:1 → 3
01111:1 → 7	00001:5 → 0
01110:1 → 7	10001:2 → 0
00011:1 → 4	10001:8 → 0
00011:4 → 4	00001:1 → 0
10011:1 → 4	01001:1 → 1
10011:1 → 4	01101:1 → 3
10011:1 → 4	01111:1 → 7
10011:7 → 4	01110:1 → 7
00011:1 → 4	00011:1 → 4



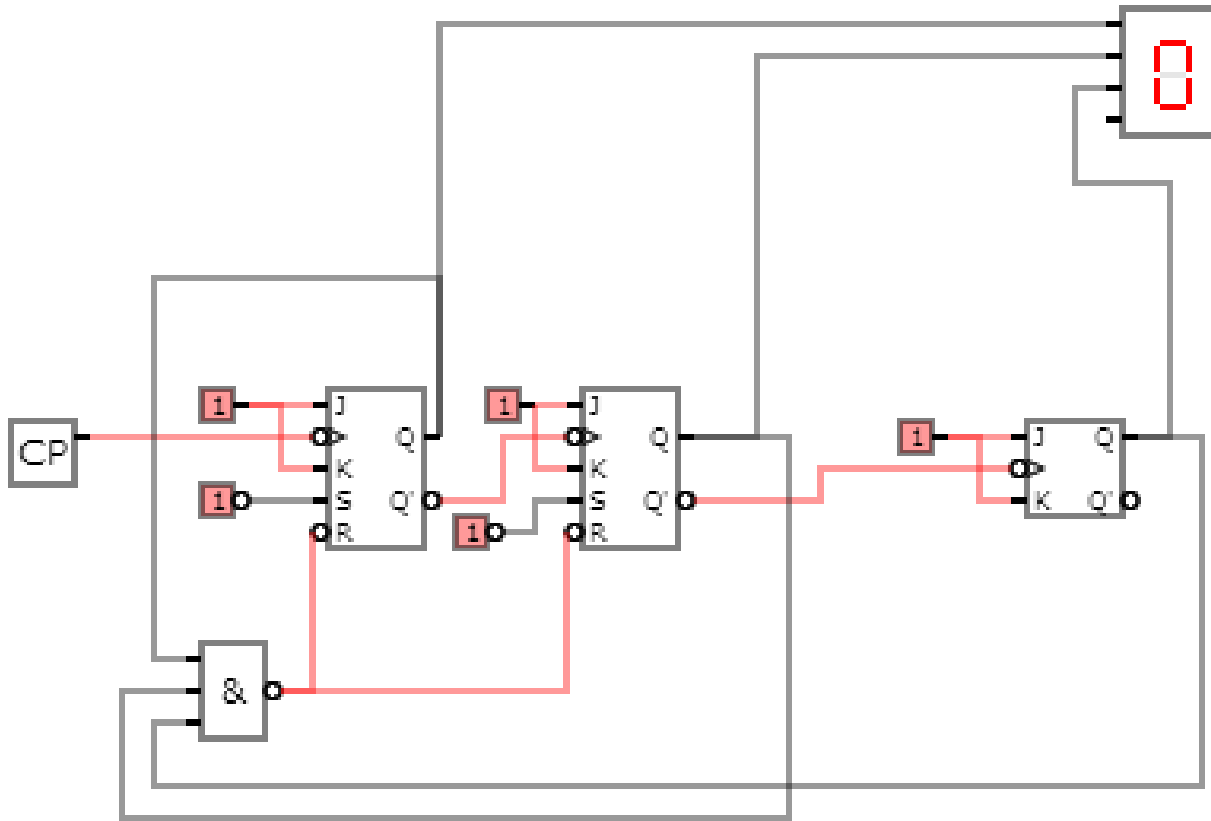
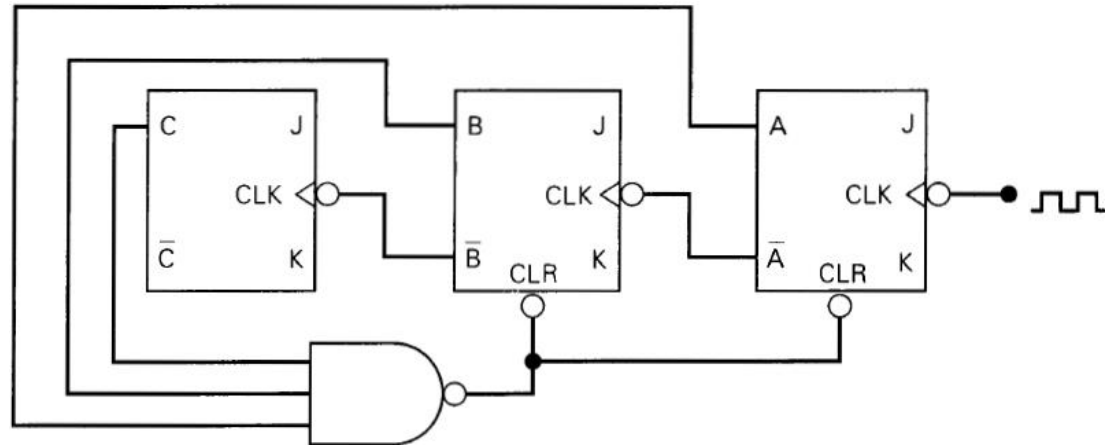
Nume semnale:
CLOCK, **A**, **B**, **C**, CLR

De fapt numaratorul trece prin starile:

0 → 1 → 3 → 7 → **4 → 4 → 4 → 4** → 5 → 7 → 3 → 0 → **0 → 0 → 0 → 0** → 1 → 3 → 7 → **4**

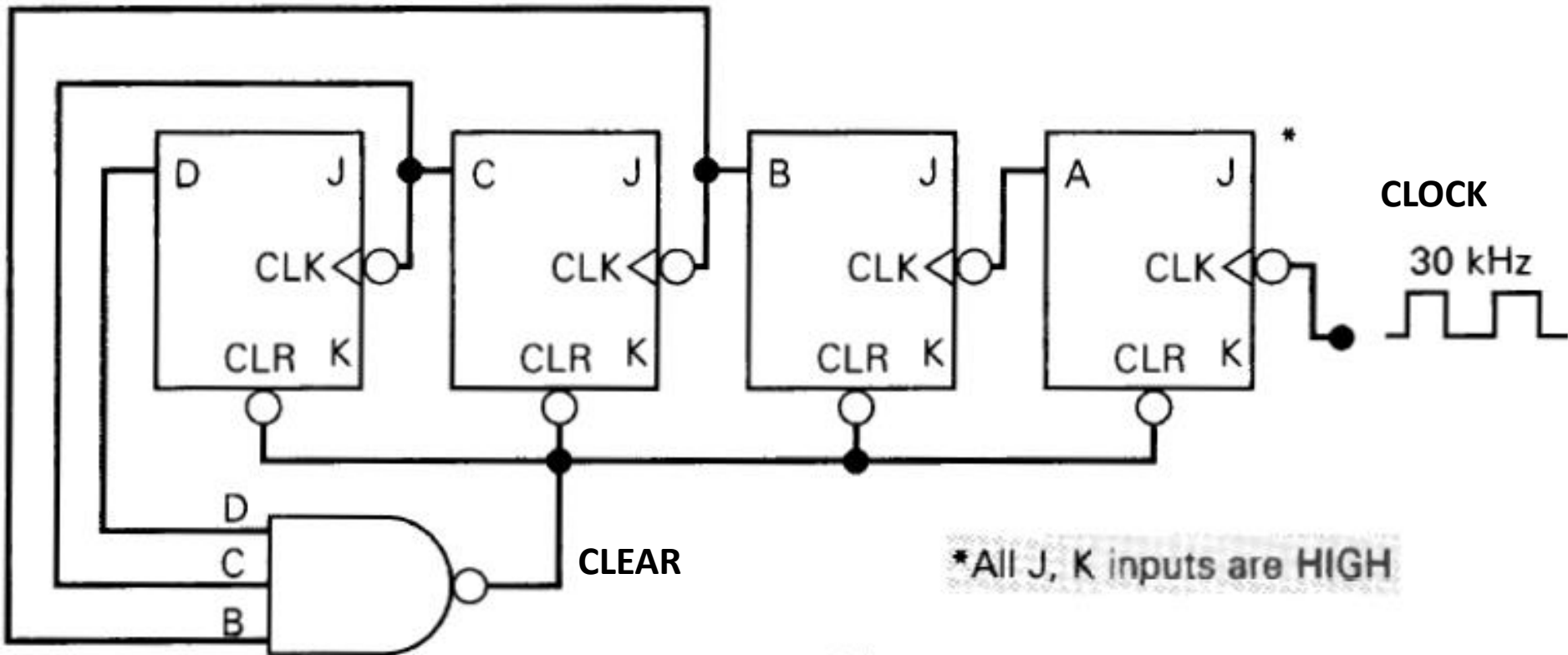
Problema 1: Raspuns (3)

TEMA: Simulati in
Wronex:



Problema 2: Numarator modulo ?

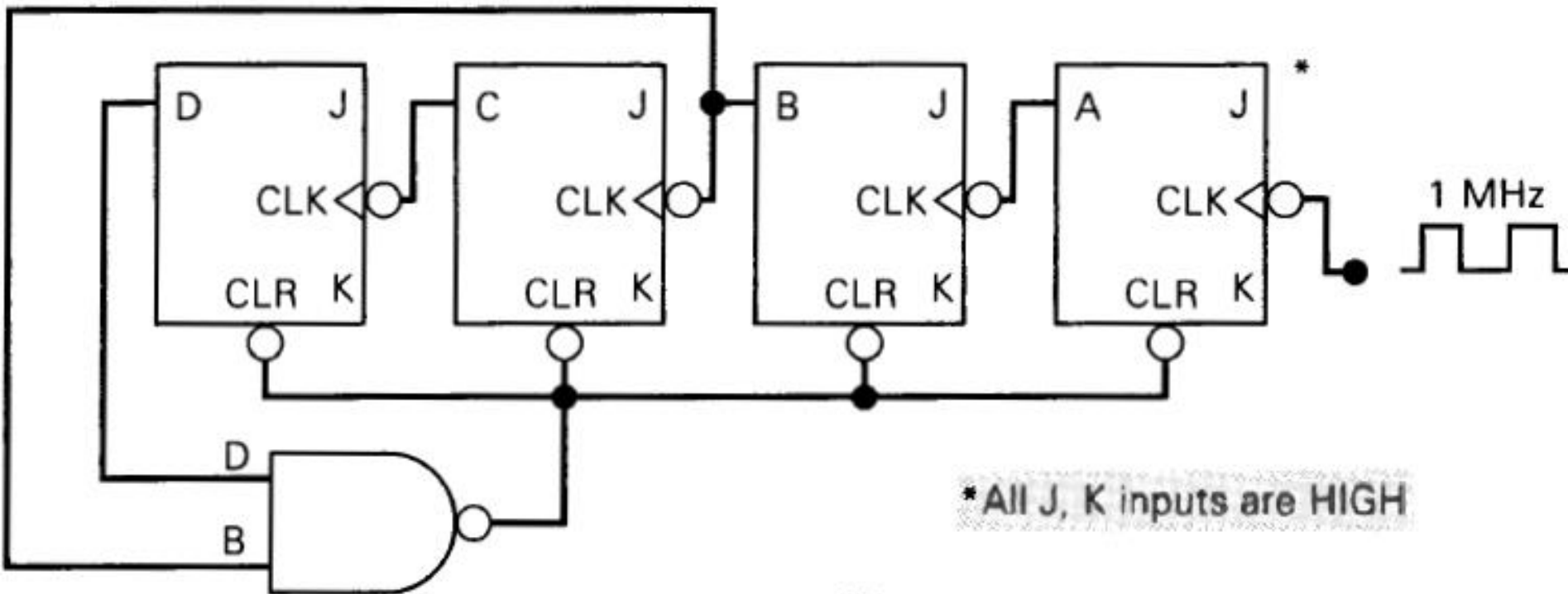
Determinati frecventa la iesirea D



TEMA: Folosind pagina [Generator de functii de unda logice.htm](http://Generator%20de%20functii%20de%20unda%20logice.htm) desenati formele de unda pentru semnalele CLOCK, CLEAR, A, B, C si D

Problema 2: Numarator modulo ?

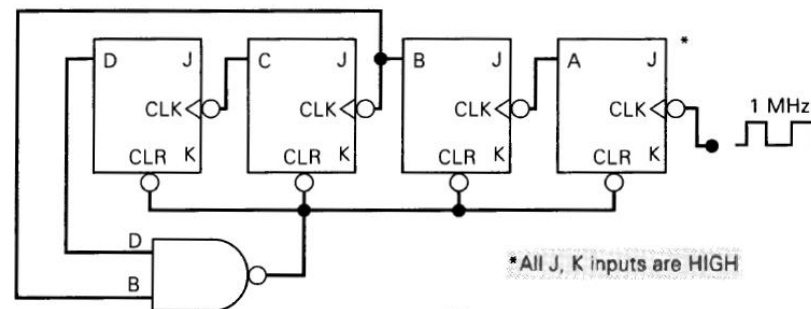
Determinati frecventa la iesirile B si C



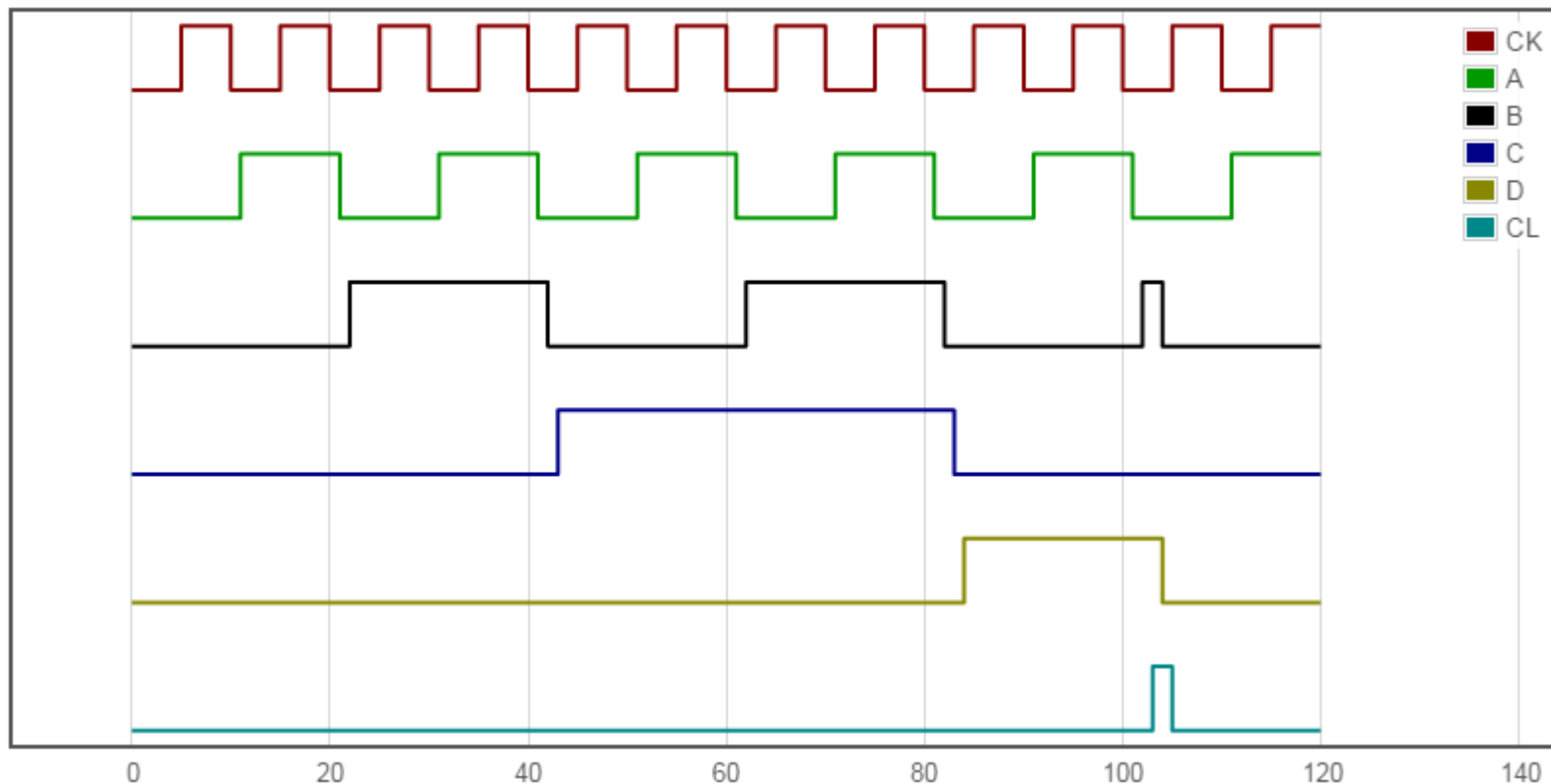
TEMA: Folosind pagina "[Generator de functii de unda logice.htm](http://www.generator-de-functii-de-unda-logice.htm)" desenati formele de unda pentru semnalele CLOCK, CLEAR, A, B, C si D.

Problema 2: Diagrama temporală

Determinați frecvența
la ieșirile B și C

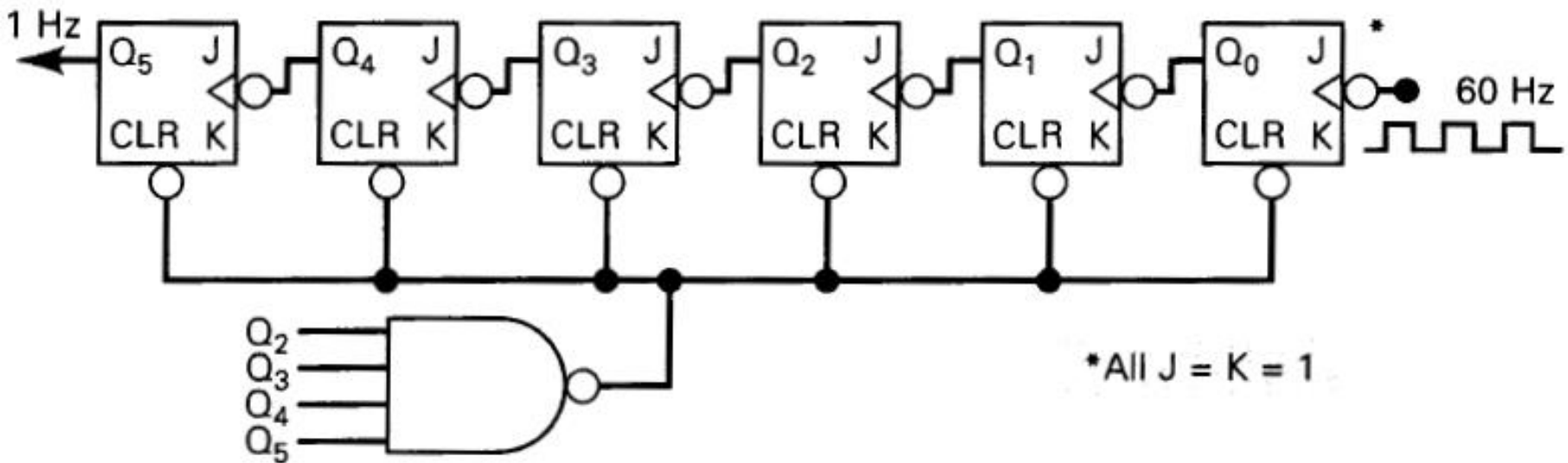


TEMA: Diagrama temporală trebuie să arate ca aici:

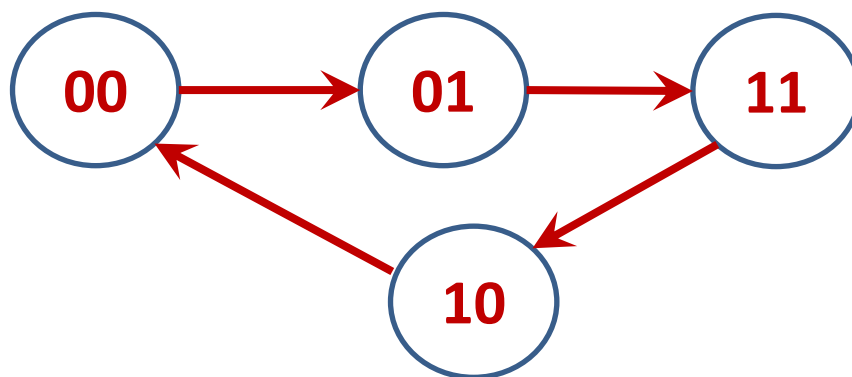


Numarator modulo 60

TEMA: Determinati frecventa la iesirile Q_3 si Q_4



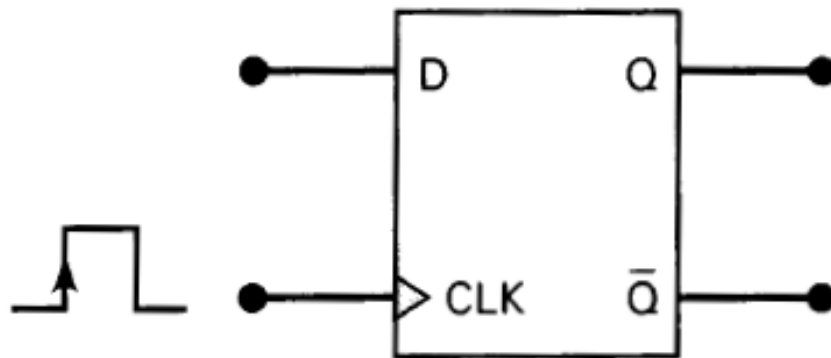
PROIECTAREA NUMARATOARELOR SINCRONE



Dorim sa facem un numarator cu 2
BB de tip JK care sa numere in
ordinea
3-2-0-1-3

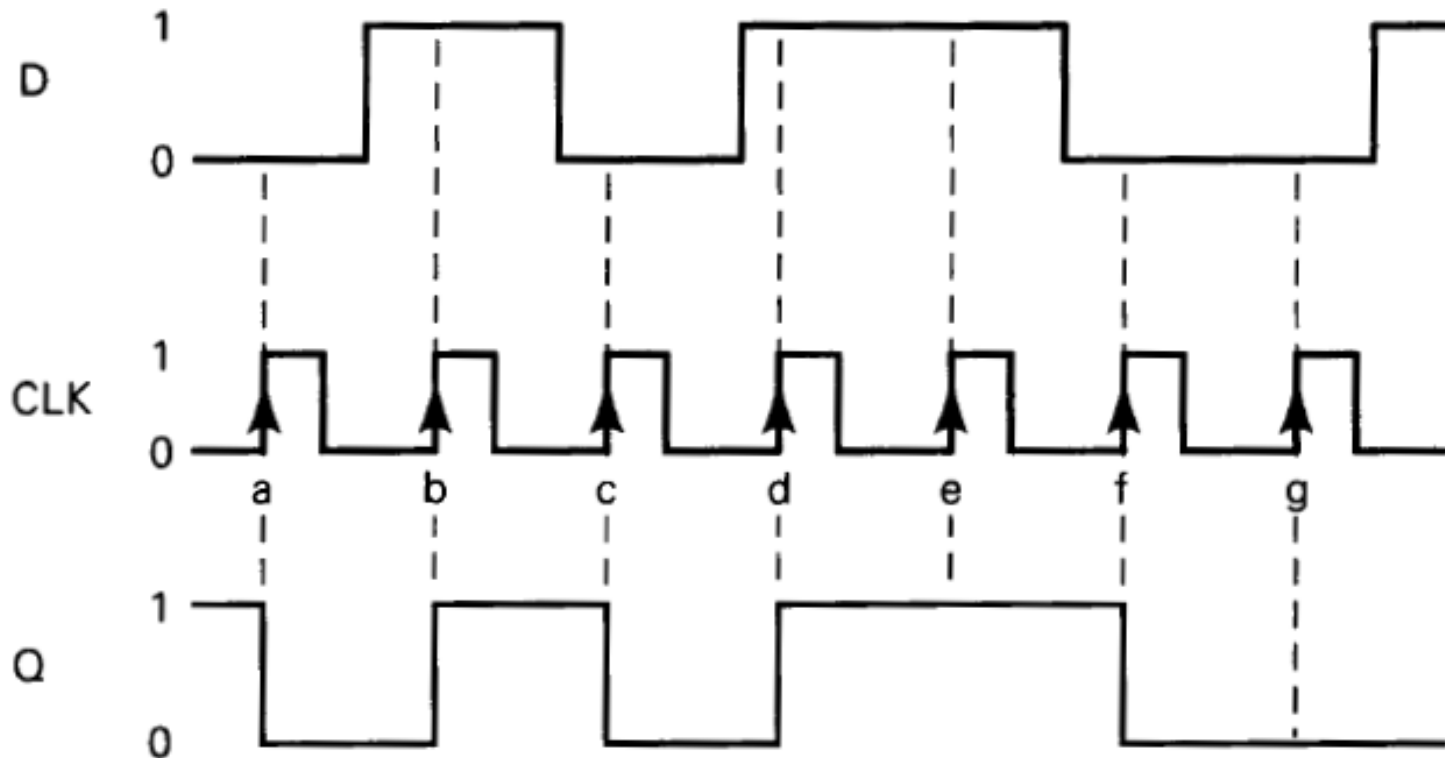
1. Cu BB de tip D
2. Cu BB de tip JK

Bistabilul de tip D: *Clocked D Flip-Flop*



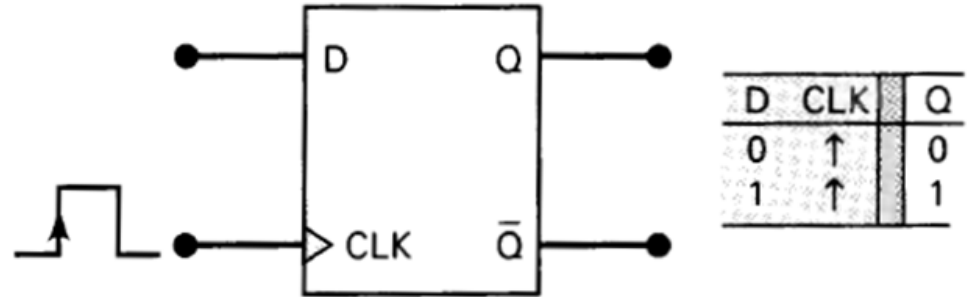
(a)

D	CLK	Q
0	↑	0
1	↑	1



Proiectare cu BB de tip D

- $\text{CLK} \uparrow \rightarrow Q = D$

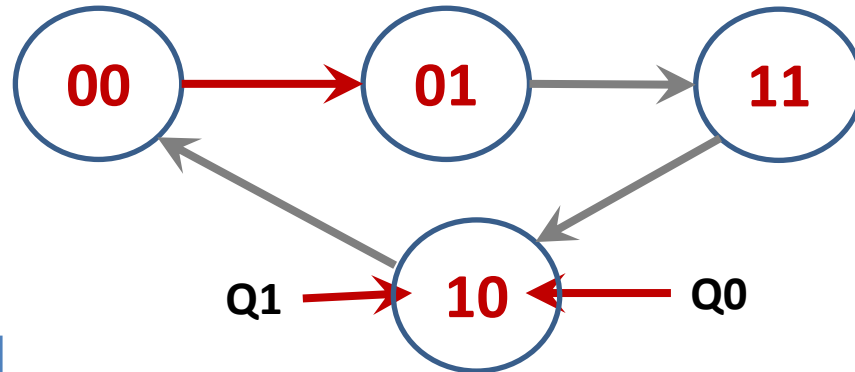


STARE

Prezenta

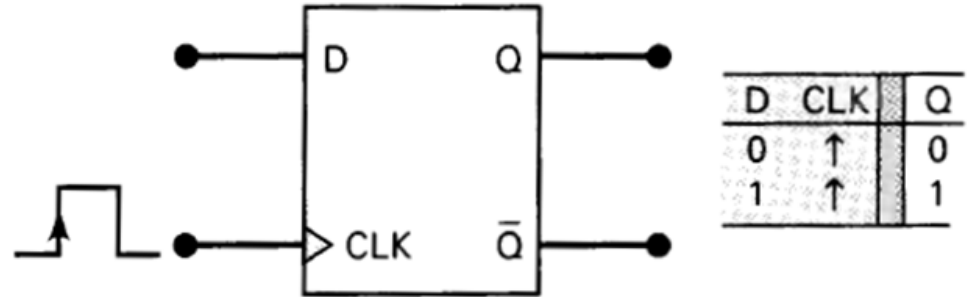
Viitoare

Prezenta		Viitoare	
Q1	Q0	D1	D0
0	0	0	1
0	1		
1	0		
1	1		



Proiectare cu BB de tip D

- $\text{CLK}\uparrow \rightarrow Q=D$

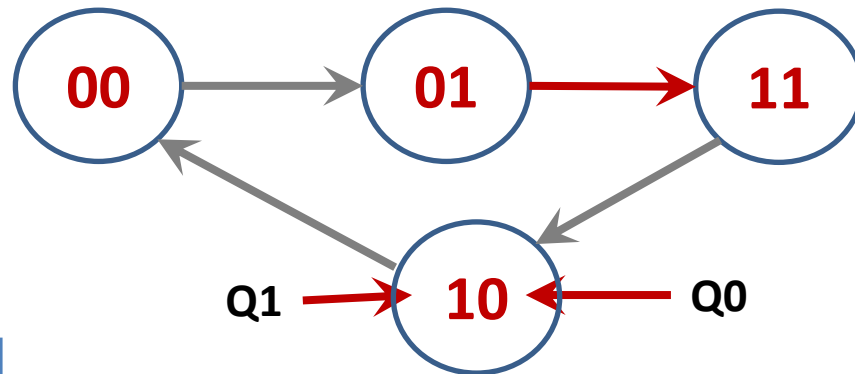


STARE

Prezenta

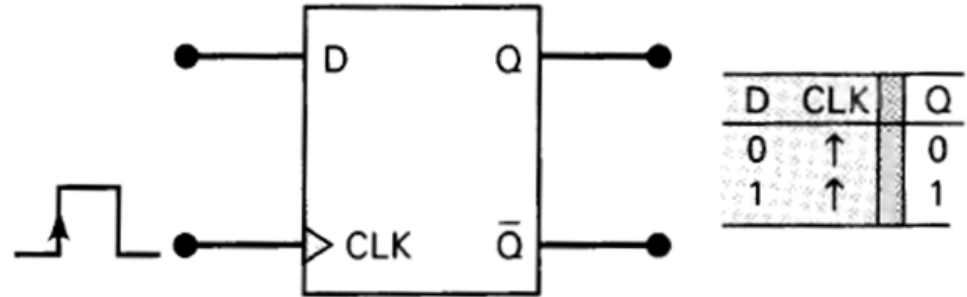
Viitoare

Prezenta		Viitoare	
Q1	Q0	D1	D0
0	0	0	1
0	1	1	1
1	0		
1	1		



Proiectare cu BB de tip D

- $\text{CLK} \uparrow \rightarrow Q = D$

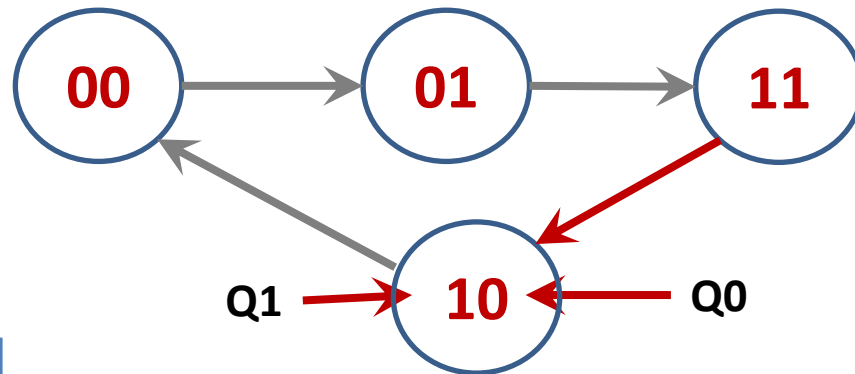


STARE

Prezenta

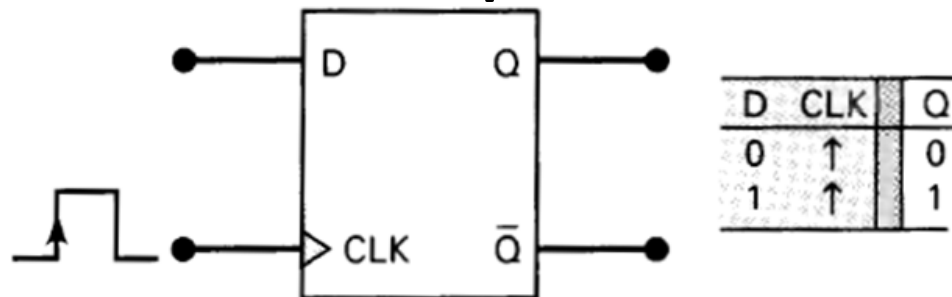
Viitoare

Prezenta		Viitoare	
Q1	Q0	D1	D0
0	0	0	1
0	1	1	1
1	0		
1	1	1	0



Proiectare cu BB de tip D

- $\text{CLK}\uparrow \rightarrow Q=D$

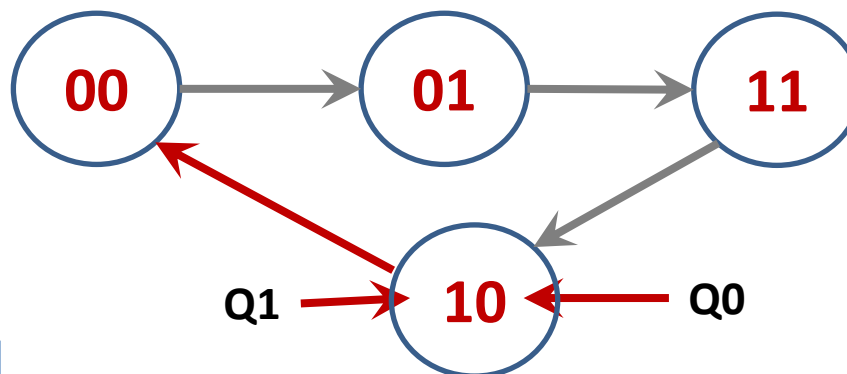


STARE

Prezenta

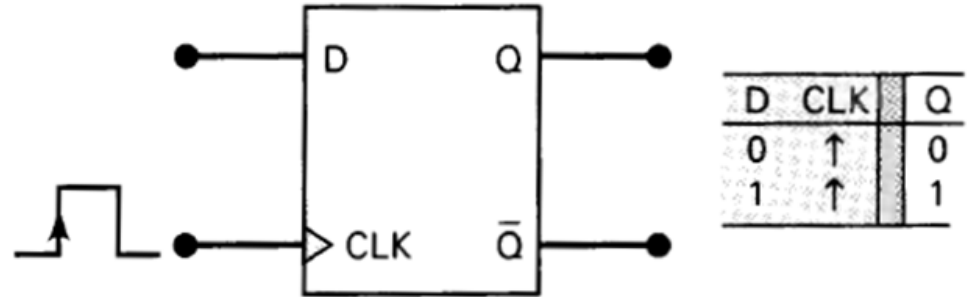
Viitoare

Prezenta		Viitoare	
Q1	Q0	D1	D0
0	0	0	1
0	1	1	1
1	0	0	0
1	1	1	0



Proiectare cu BB de tip D

- $\text{CLK}\uparrow \rightarrow Q=D$

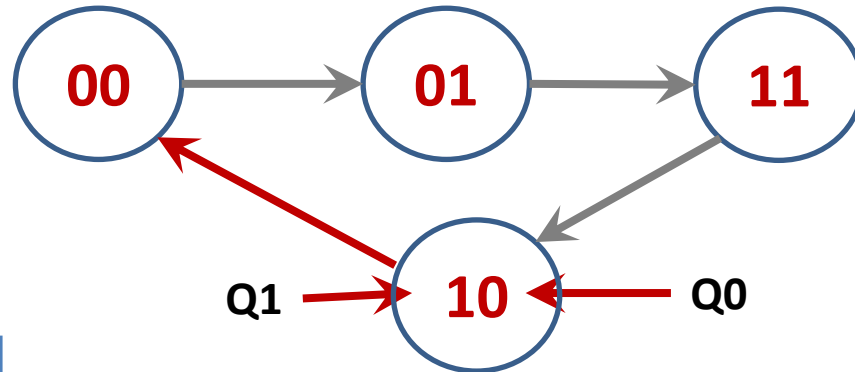


STARE

Prezenta

Viitoare

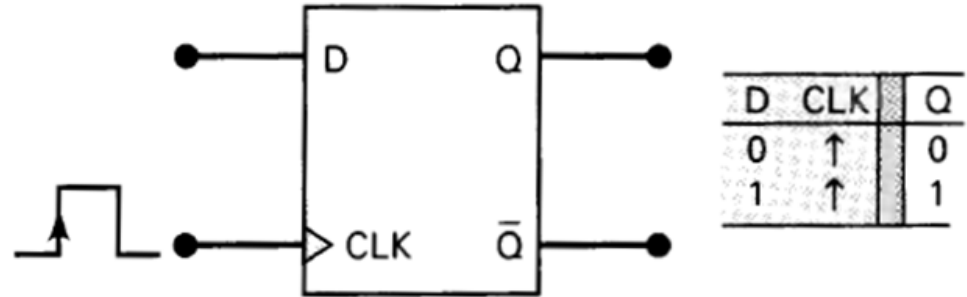
Prezenta		Viitoare	
Q1	Q0	D1	D0
0	0	0	1
0	1	1	1
1	0	0	0
1	1	1	0



$$D1 = Q0$$

Proiectare cu BB de tip D

- $\text{CLK}\uparrow \rightarrow Q=D$

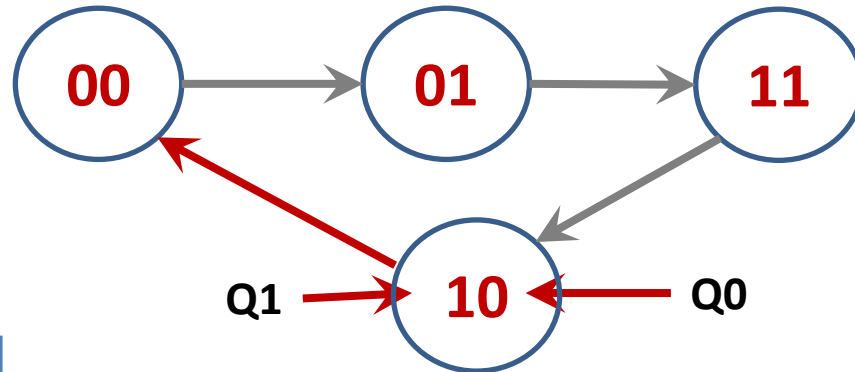


STARE

Prezenta

Viitoare

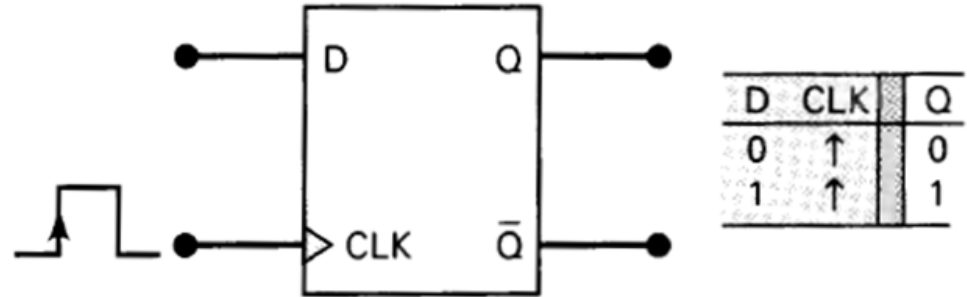
Prezenta		Viitoare	
Q1	Q0	D1	D0
0	0	0	1
0	1	1	1
1	0	0	0
1	1	1	0



$$D0 = \text{NOT } Q1 = !Q1 = Q1'$$

Proiectare cu BB de tip D

- $\text{CLK} \uparrow \rightarrow Q = D$

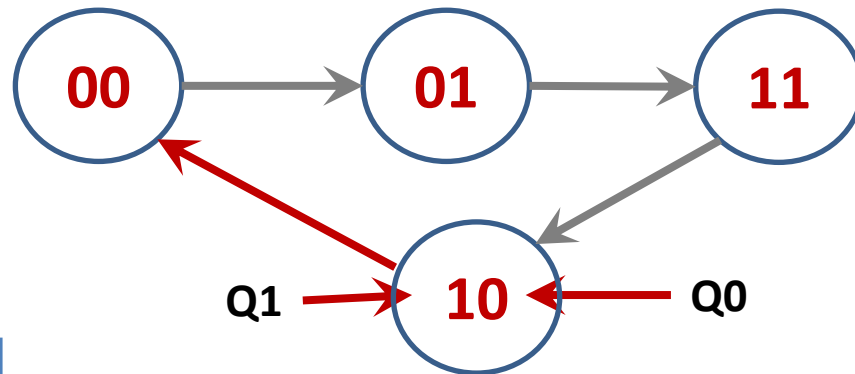


STARE

Prezenta

Viitoare

Prezenta		Viitoare	
Q1	Q0	D1	D0
0	0	0	1
0	1	1	1
1	0	0	0
1	1	1	0



$$D1 = Q0$$

$$D0 = !Q1$$

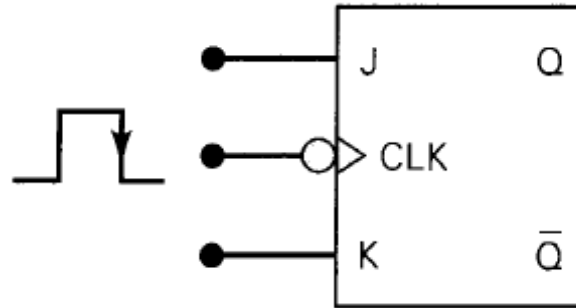
- D1 = Q0** 0 - 1 - 3 - 2 - 0

D0 = !Q1

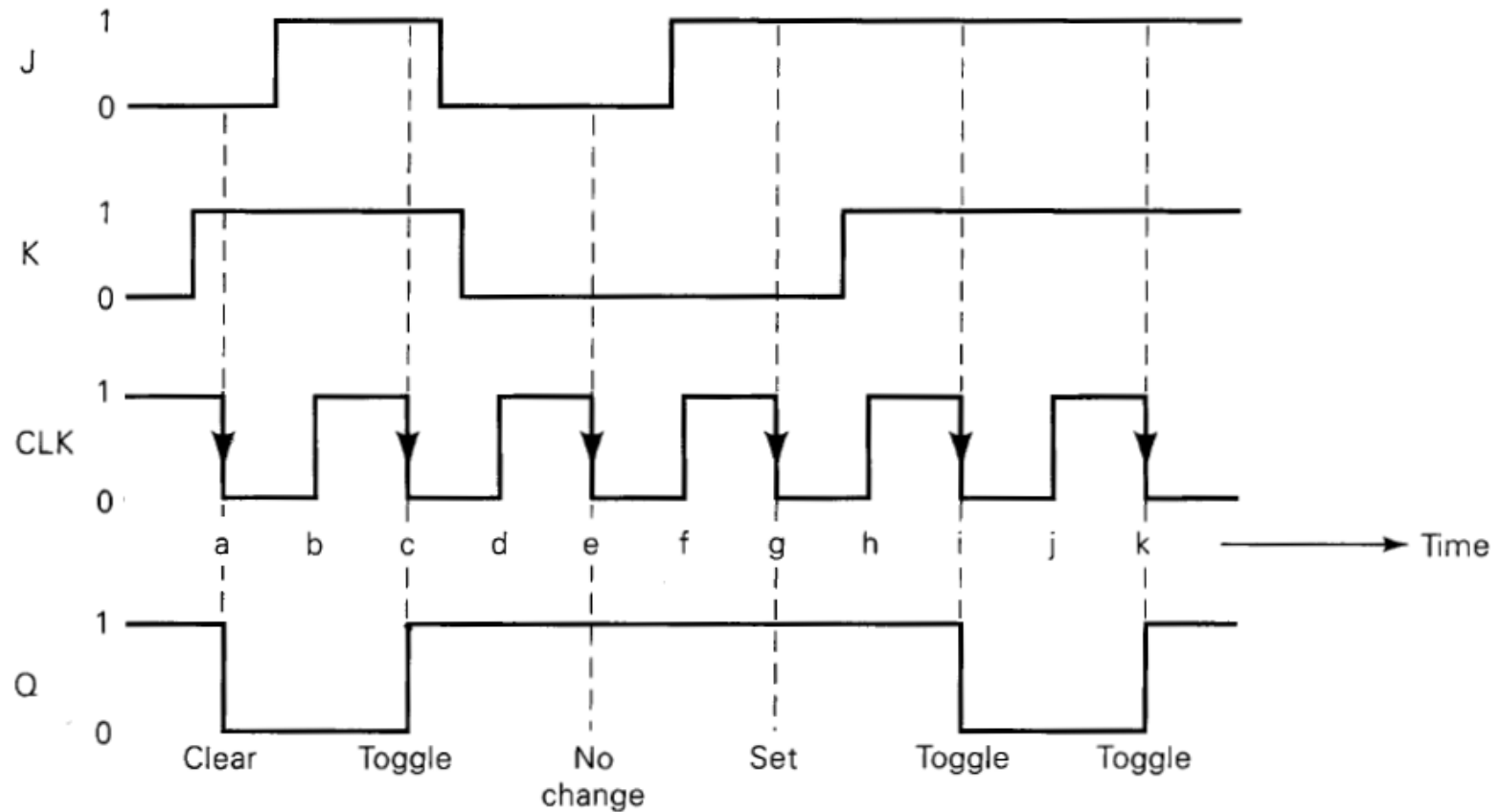
Se putea implementa fara inversor?

Bistabilul JK: tranzitie pe frontul negativ*

39



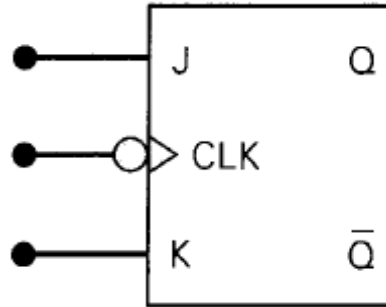
J	K	CLK	Q
0	0	↓	Q_0 (no change)
1	0	↓	1
0	1	↓	0
1	1	↓	$\overline{Q_0}$ (toggles)



Excitation table : BB JK

- Dorim gasim o tabela pentru valorile intrarilor JK astfel incat sa putem controla starea viitoare a BB JK.

Q	Q _{next}	J	K
0	→ 0	0	X
0	1	1	X
1	0	X	1
1	1	X	0



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

- Daca BB este in starea **Q=0**, care sunt starile JK care asigura ca urmatoarea stare este **Q=0**.

1. JK=01(Reset)

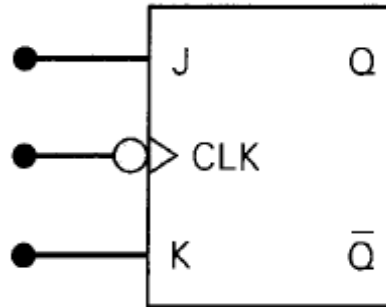
2. JK=00 (no change → memorare)

Adica JK=**0X**

Excitation table : BB JK

- Dorim gasim o tabela pentru valorile intrarilor JK astfel incat sa putem controla starea viitoare a BB JK.

Q	Q _{next}	J	K
0	0	0	X
0 → 1	1	1	X
1	0	X	1
1	1	X	0



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

- Daca BB este in starea **Q=0**, care sunt starile JK care asigura ca urmatoarea stare este **Q=1**.

1. JK=10(Set)

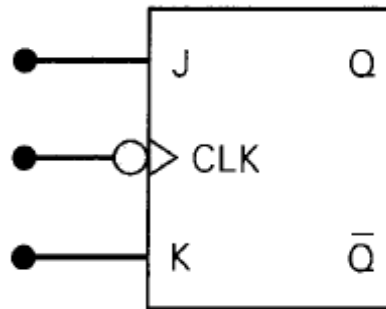
2. JK=11 (toggles)

} Adica JK=**1X**

Excitation table : BB JK

- Dorim gasim o tabela pentru valorile intrarilor JK astfel incat sa putem controla starea viitoare a BB JK.

Q	Q _{next}	J	K
0	0	0	X
0	1	1	X
1 →	0	X	1
1	1	X	0



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

- Daca BB este in starea **Q=1**, care sunt starile JK care asigura ca urmatoarea stare este **Q=0**.

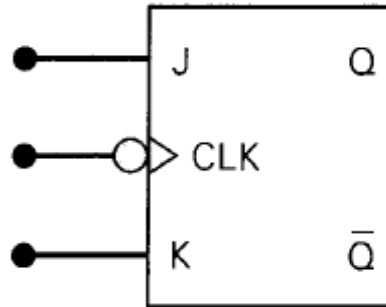
- JK=01(Reset)
- JK=11 (toggles)

} Adica JK=**X1**

Excitation table : BB JK

- Dorim gasim o tabela pentru valorile intrarilor JK astfel incat sa putem controla starea viitoare a BB JK.

Q	Q _{next}	J	K
0	0	0	X
0	1	1	X
1	0	X	1
1 → 1	1	X	0



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

- Daca BB este in starea **Q=1**, care sunt starile JK care asigura ca urmatoarea stare este **Q=1**.

1. JK=10(Set)

2. JK=00 (no change)

} Adica JK=**X0**

Diagrame Karnaugh cu Xuri

- Tema gasiti forme minimale pentru FCD si FCC pentru tabela urmatoare
- NOUTATEA : alegem pentru X valoarea care ne convine cel mai mult.

		AB			
		00	01	11	10
CD	00	1	0	0	1
	01	0	1	1	0
	11	0	1	X	0
	10	X	0	0	X

SOLUTIE.

FCDmin= $\mathbf{BD+B'D'}$ $\rightarrow$ X-urile sunt luate 1

FCCmin= $\mathbf{(B+D')(B'+D)(A'+C')(C'+D)}$ $\rightarrow$ X-urile sunt luate 0

Diagrame Karnaugh cu Xuri

- Tema gasiti forme minimale pentru FCD si FCC pentru tabela urmatoare
- NOUTATEA : alegem pentru X valoarea care ne convine cel mai mult.

		AB			
		00	01	11	10
CD	00	1	0	0	1
	01	0	1	1	0
	11	0	1	X	0
	10	X	0	0	X

SOLUTIE.

FCDmin= $\underbrace{BD+B'D'} \rightarrow$ X-urile sunt luate 1

FCCmin= $(B+D')(B'+D)(A'+C')(C'+D) \rightarrow$ X-urile sunt luate 0

Diagrame Karnaugh cu Xuri

- Tema gasiti forme minimale pentru FCD si FCC pentru tabela urmatoare
- NOUTATEA : alegem pentru X valoarea care ne convine cel mai mult.

		AB			
		00	01	11	10
CD	00	1	0	0	1
	01	0	1	1	0
	11	0	1	X	0
	10	X	0	0	X

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

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		AB			
		00	01	11	10
CD	00	1	0	0	1
	01	0	1	1	0
	11	0	1	X	0
	10	X	0	0	X

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FCDmin= $\mathbf{BD+B'D'}$ $\rightarrow$ X-urile sunt luate 1

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Diagrame Karnaugh cu Xuri

- Tema gasiti forme minimale pentru FCD si FCC pentru tabela urmatoare
- NOUTATEA : alegem pentru X valoarea care ne convine cel mai mult.

		AB			
		00	01	11	10
CD	00	1	0	0	1
	01	0	1	1	0
	11	0	1	X	0
	10	X	0	0	X

SOLUTIE.

FCDmin= $\mathbf{BD+B'D'}$ $\rightarrow$ X-urile sunt luate 1

FCCmin= $\mathbf{(B+D')(B'+D)(A'+C')(C'+D)}$ $\rightarrow$ X-urile sunt luate 0

Diagrame Karnaugh cu Xuri

- Tema gasiti forme minimale pentru FCD si FCC pentru tabela urmatoare
- NOUTATEA : alegem pentru X valoarea care ne convine cel mai mult.

		AB			
		00	01	11	10
CD	00	1	0	0	1
	01	0	1	1	0
	11	0	1	X	0
	10	X	0	0	X

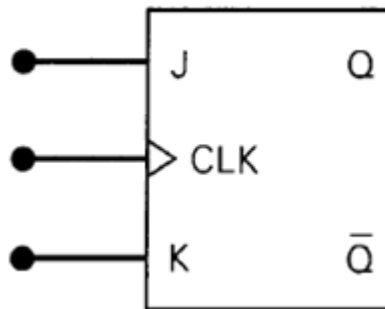
SOLUTIE.

FCDmin= **$BD+B'D'$** $\rightarrow$ X-urile sunt luate 1

FCCmin= **$(B+D')(B'+D)(A'+C')(C'+D)$** $\rightarrow$ X-urile sunt luate 0

Proiectare cu BB de tip JK

- CLK↑

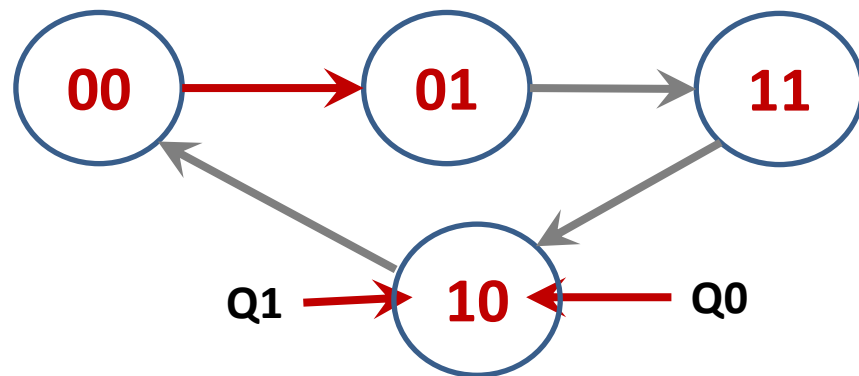


J	K	CLK	Q
0	0	↑	Q_0 (no change)
1	0	↑	1
0	1	↑	0
1	1	↑	$\overline{Q_0}$ (toggles)

STARE

Prezenta Viitoare

Prezenta		Viitoare					
Q1	Q0	Q1	Q0	J1	K1	J0	K0
0	0	0	1	0	X	1	X
0	1	1	1	1	X	X	0
1	0	0	0	X	1	0	X
1	1	1	0	X	0	X	1



Excitation table

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

Proiectare cu BB de tip JK

- CLK↑

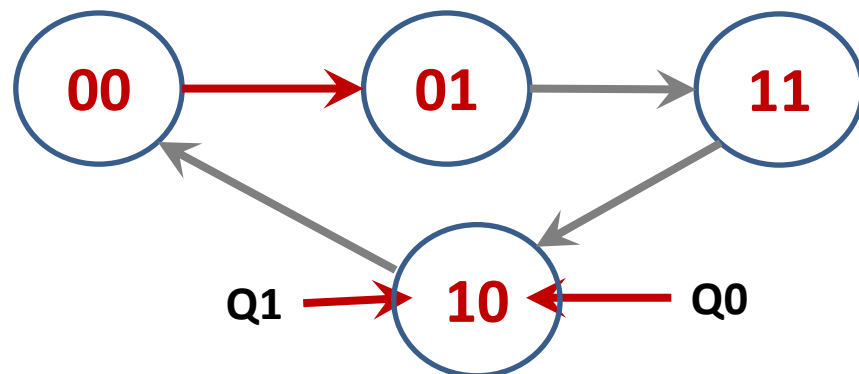
Excitation table

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

STARE

Prezenta Viitoare

Prezenta		Viitoare					
Q1	Q0	Q1	Q0	J1	K1	J0	K0
0	0	0	1	0	X	1	X
0	1	1	1	1	X	X	0
1	0	0	0	X	1	0	X
1	1	1	0	X	0	X	1

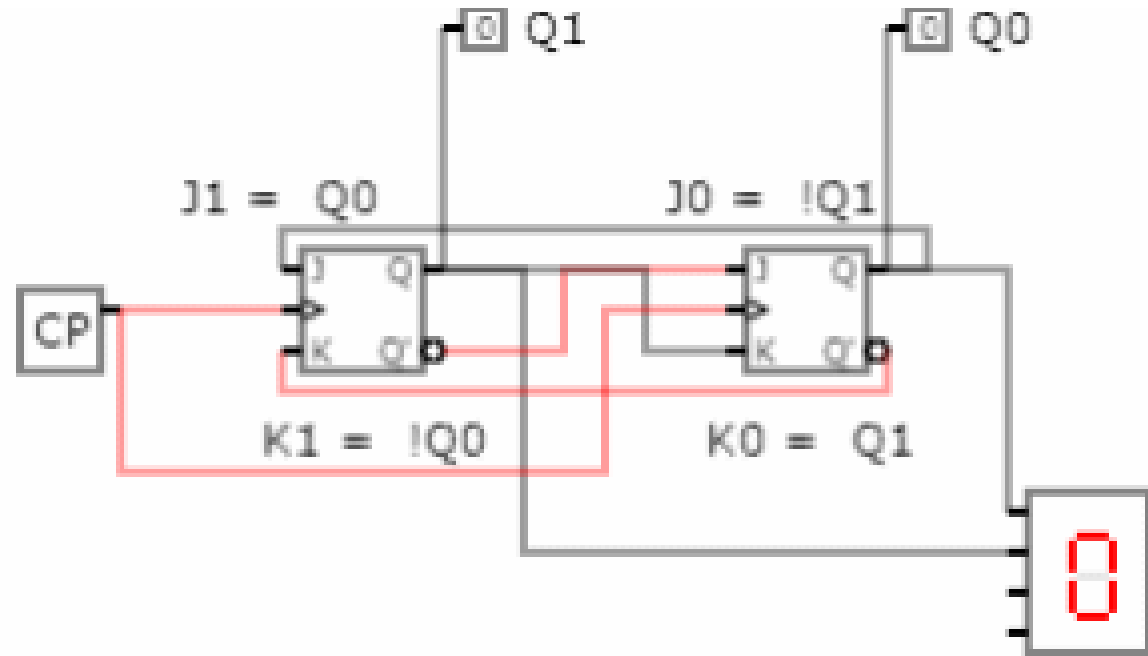


0 – 1 – 3 – 2 – 0

$$\begin{aligned}
 J1 &= Q0 \\
 K1 &= !Q0 \\
 J0 &= !Q1 \\
 K0 &= Q1
 \end{aligned}$$

Proiectare cu BB de tip JK

- CLK↑



STARE

Prezenta Viitoare

Q1	Q0	Q1	Q0	J1	K1	J0	K0
0	0	0	1	0	X	1	X
0	1	1	1	1	X	X	0
1	0	0	0	X	1	0	X
1	1	1	0	X	0	X	1

0 - 1 - 3 - 2 - 0

$$\begin{aligned}
 J1 &= Q0 \\
 K1 &= !Q0 \\
 J0 &= !Q1 \\
 K0 &= Q1
 \end{aligned}$$

Proiectare cu BB de tip JK

- CLK↑

$$J1 = Q0$$

$$K1 = !Q0$$

$$J0 = !Q1$$

$$K0 = Q1$$

STARE

Prezenta Viitoare

Prezenta		Viitoare					
Q1	Q0	Q1	Q0	J1	K1	J0	K0
0	0	0	1	0	X	1	X
0	1	1	1	1	X	X	0
1	0	0	0	X	1	0	X
1	1	1	0	X	0	X	1

Tabela de adevăr

A	B	F(AB)
0	0	0
0	1	1
1	0	X
1	1	X

Diagrama Karnaugh

		A	
		0	1
B	0	0	X
	1	1	X

$$F(AB) = B$$

0 - 1 - 3 - 2 - 0

Proiectare cu BB de tip JK

- CLK↑

$$J1 = Q0$$

$$K1 = !Q0$$

$$J0 = !Q1$$

$$K0 = Q1$$

STARE

Prezenta Viitoare

Prezenta		Viitoare					
Q1	Q0	Q1	Q0	J1	K1	J0	K0
0	0	0	1	0	X	1	X
0	1	1	1	1	X	X	0
1	0	0	0	X	1	0	X
1	1	1	0	X	0	X	1

Tabela de adevăr

A	B	F(AB)
0	0	X
0	1	X
1	0	1
1	1	0

Diagrama Karnaugh

		A	
		0	1
B	0	X	1
	1	X	0

$$F(AB) = \bar{B}$$

0 - 1 - 3 - 2 - 0

Proiectare cu BB de tip JK

• CLK↑

$$J1 = Q0$$

$$K1 = !Q0$$

$$J0 = !Q1$$

$$K0 = Q1$$

STARE

Prezenta Viitoare

Prezenta		Viitoare					
Q1	Q0	Q1	Q0	J1	K1	J0	K0
0	0	0	1	0	X	1	X
0	1	1	1	1	X	X	0
1	0	0	0	X	1	0	X
1	1	1	0	X	0	X	1

Tabela de adevăr

A	B	F(AB)
0	0	1
0	1	X
1	0	0
1	1	X

Diagrama Karnaugh

		A	
		0	1
B	0	1	0
	1	X	X

$$F(AB) = \bar{A}$$

0 – 1 – 3 – 2 – 0

Proiectare cu BB de tip JK

- CLK↑

$$J1 = Q0$$

$$K1 = !Q0$$

$$J0 = !Q1$$

$$K0 = Q1$$

STARE

Prezenta Viitoare

Prezenta		Viitoare					
Q1	Q0	Q1	Q0	J1	K1	J0	K0
0	0	0	1	0	X	1	X
0	1	1	1	1	X	X	0
1	0	0	0	X	1	0	X
1	1	1	0	X	0	X	1

Tabela de adevăr

A	B	F(AB)
0	0	X
0	1	0
1	0	X
1	1	1

Diagrama Karnaugh

		A	
		0	1
B	0	X	X
	1	0	1

$$F(AB) = A$$

0 – 1 – 3 – 2 – 0



Multumesc pentru atentie