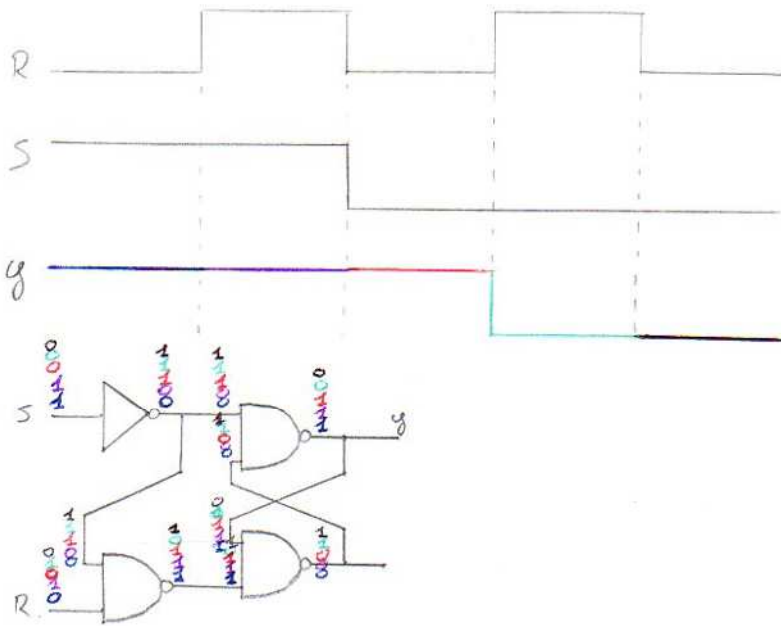


## EXERCICE 1

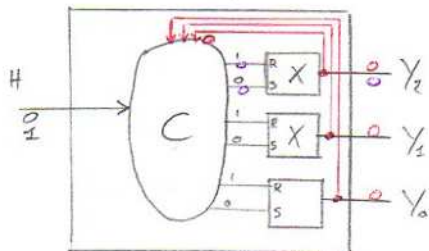
S	R	$\bar{R}$	$y = (y+S) \cdot \bar{R}$	$y \cdot \bar{R} + S$	$(y+S \cdot \bar{R})(S+\bar{R})$
0	0	1	y	y	y
0	1	0	0	0	0
1	0	1	1	1	1
1	1	0	0	1	y

## EXERCICE 2



NAND:  $\begin{cases} 0 & \text{si } (1,1) \\ 1 & \text{sinon} \end{cases}$

## EXERCICE 3



ou force à 0.

H	Y <sub>2</sub>	Y <sub>1</sub>	Y <sub>0</sub>	R <sub>2</sub>	S <sub>2</sub>	R <sub>1</sub>	S <sub>1</sub>	R <sub>0</sub>	S <sub>0</sub>
0	0	0	0	1	0	0	0	0	0
1	0	0	1	0	0	0	0	0	1
0	0	1	1	0	0	0	1	0	0
1	0	1	0	0	0	0	0	1	0
0	1	1	0	0	1	0	0	0	0
1	1	1	1	0	0	0	0	0	1
0	1	0	1	0	0	1	0	0	0
1	1	0	0	0	0	0	0	1	0

On force l'entrée

Quand y passe de 1 à 0 : R = 1 sinon R = 0

Quand y passe de 0 à 1 : S = 1 sinon S = 0

$$R_2 = \bar{Y}_2 \cdot \bar{Y}_1 \cdot \bar{Y}_0 \cdot H$$

$$S_2 = \bar{Y}_2 \cdot Y_1 \cdot Y_0 \cdot \bar{H}$$

$$R_1 = Y_2 \cdot \bar{Y}_1 \cdot Y_0 \cdot \bar{H}$$

$$S_1 = \bar{Y}_2 \cdot Y_1 \cdot Y_0 \cdot H$$

$$R_0 = \bar{Y}_2 \cdot Y_1 \cdot \bar{Y}_0 \cdot H + Y_2 \cdot \bar{Y}_1 \cdot \bar{Y}_0 \cdot H$$

$$S_0 = \bar{Y}_2 \cdot \bar{Y}_1 \cdot Y_0 \cdot H + Y_2 \cdot Y_1 \cdot Y_0 \cdot H$$

## EXERCICE 4

$$Y_A = YS + Y\bar{R} + S\bar{R} \Rightarrow \begin{matrix} X \\ S \end{matrix} \begin{matrix} Y \\ R \end{matrix}$$

	H	Y <sub>2</sub>	Y <sub>1</sub>	Y <sub>0</sub>	Y <sub>A2</sub>	Y <sub>A1</sub>	Y <sub>A0</sub>
4 S	0	1	0	0	1	0	0
12 T	1	1	0	0	1	1	0
14 S	1	1	1	0	1	1	0
6 T	0	1	1	0	0	1	0
2 S	0	0	1	0	0	1	0
10 T	1	0	1	0	0	1	1
11 S	1	0	1	1	0	1	1
3 T	0	0	1	1	0	0	1
1 S	0	0	0	1	0	0	1
9 T	1	0	0	1	1	0	1
13 S	1	1	0	1	1	0	1
5 T	0	1	0	1	1	0	0

$$Y_{A2} = Y_2 \bar{Y}_1 + H \bar{Y}_1 + H Y_2$$

$$\Rightarrow \begin{cases} R_2 = Y_1 \\ S_2 = H \end{cases}$$

$$Y_{A1} = Y_1 \bar{Y}_0 + Y_1 H + \bar{Y}_0 H$$

$$\Rightarrow \begin{cases} R_1 = Y_0 \\ S_1 = H \end{cases}$$

$$Y_{A0} = \bar{Y}_2 Y_0 + H Y_0 + H \bar{Y}_2$$

$$\Rightarrow \begin{cases} R_0 = Y_2 \\ S_0 = H \end{cases}$$

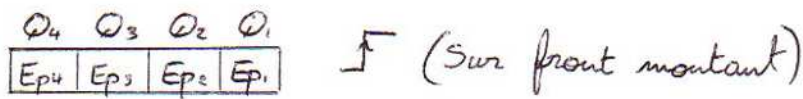
	Y <sub>2</sub>	Y <sub>1</sub>	Y <sub>0</sub>
X	0	1	2
Y <sub>2</sub>	1	1	x
H	1	1	x
Y <sub>1</sub>	x	1	1
Y <sub>0</sub>			1
		x	1
	1	x	1
	x	1	1

(0, 7, 8, 15)

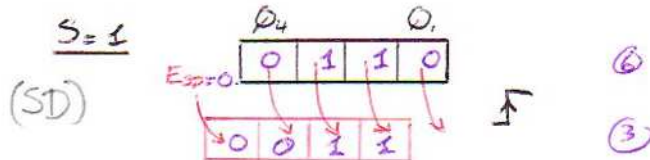
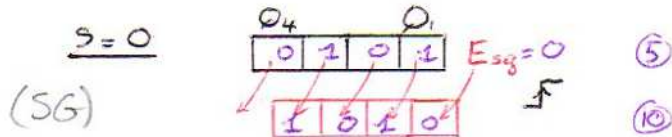
# EXERCICE 3

TD n° 2

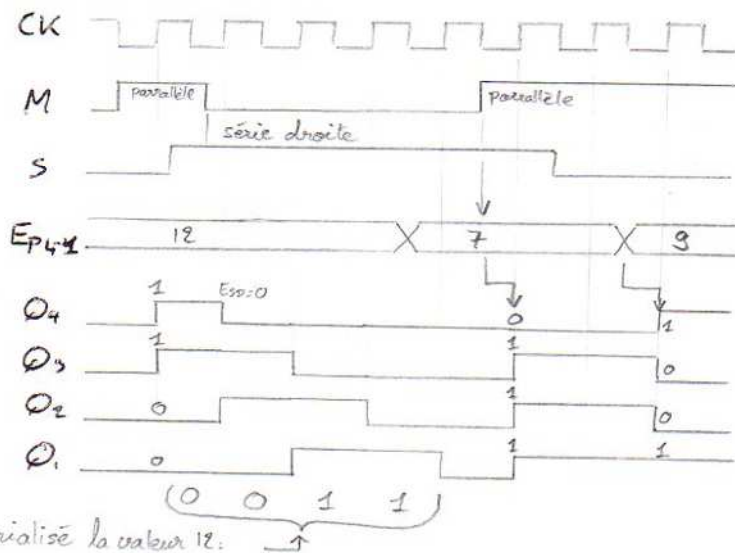
M=1 (P)



M=0 (S)



exemple (On pose  $E_{sg} = E_{sd} = 0$ )



12: 1100  
 7: 0111  
 3: 1001

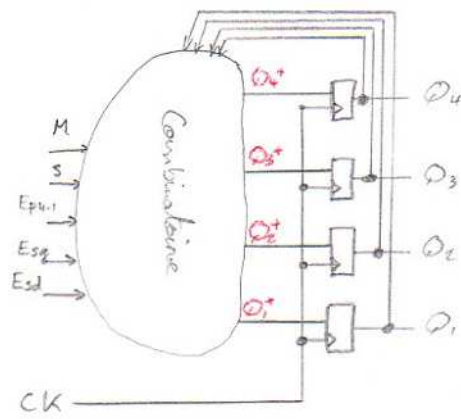
(front montant !)

On a sérialisé la valeur 12:

a.	M	S	$Q_4$	$Q_3$	$Q_2$	$Q_1$
0	0		$Q_3$	$Q_2$	$Q_1$	$E_{sg}$
0	1		$E_{sd}$	$Q_4$	$Q_3$	$Q_2$
1	X		$E_{p4}$	$E_{p3}$	$E_{p2}$	$E_{p1}$

→ en fonction de l'état précédent

→ en fonction des  $E_{pi}$  du moment.



b. Les  $D_i$  sont les valeurs  $Q_i$  que l'on souhaite avoir. ( $Q_i^+$ )

$$\begin{cases} D_1 = \bar{M} \bar{S} E_{sd} + \bar{M} S Q_2 + M E_{p1} \\ D_2 = \bar{M} \bar{S} Q_1 + \bar{M} S Q_3 + M E_{p2} \\ D_3 = \bar{M} \bar{S} Q_2 + \bar{M} S Q_4 + M E_{p3} \\ D_4 = \bar{M} \bar{S} Q_3 + \bar{M} S E_{sd} + M E_{p4} \end{cases}$$

TD3

## EXERCICE 1

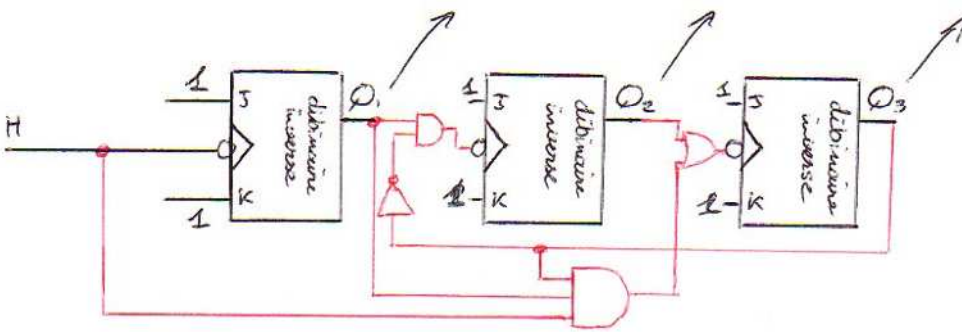
	cycle complet			cycle incomplet		
	$Q_3$	$Q_2$	$Q_1$	$z_3$	$z_2$	$z_1$
0	0	0	0			1
1	0	0	1		1	1
2	0	1	0			1
3	0	1	1	1	1	1
4	1	0	0			1
5	1	0	1		1	1
6	1	1	0			1

$z_1 = H$   
 $z_2 = Q_1$   
 $z_3 = Q_2$

$z_1 = H$   
 $z_2 = Q_1 \cdot f = 0$   
 $z_3 = Q_2 + gH = 0$

front descendant de  
 $Q_i \Rightarrow g_{ci} = 1$

On cherche  $f$  et  $g$  afin d'avoir le tableau en cycle incomplet



## EXERCICE 2

0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0

	$Q_3$	$Q_2$	$Q_1$	$Q_0$	$RA_3$	$RA_2$	$RA_1$	$RA_0$	$RA_3$	$RA_2$	$RA_1$	$RA_0$
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	0	X	X	0	1	0	1	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	X	0	1	0	X	0	X	0
12	1	1	0	0								
13	1	1	0	1								
14	1	1	1	0								
15	1	1	1	1								



	$Q_0$		$Q_1$	
$Q_0^+$	1			1
$Q_1$	1		x	x
	1		x	x
upcler	1			1

	$Q_1$		$Q_2$	
$Q_1^+$		1		
	1	x	x	
		x	x	
		1		1

	$Q_2$		$Q_3$	
$Q_2^+$	1			
	1	x	x	
	1	x	x	
		1		

$$Q_0^+ = \overline{Q_0}$$

$$Q_1^+ = Q_0 Q_1 \overline{Q_2} + \overline{Q_0} Q_2 \text{upcler} + Q_0 \overline{Q_1} \overline{Q_2} \text{upcler} + \overline{Q_0} Q_1 \text{upcler}$$

$$Q_2^+ = Q_0 Q_2 \text{upcler} + Q_0 Q_1 \text{upcler} + \overline{Q_0} Q_2 \text{upcler} + \overline{Q_0} \overline{Q_1} \overline{Q_2} \text{upcler}$$

→ AND → OR →

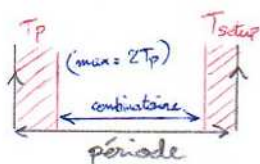
Temps de propagation :

BASCULE

$$\begin{cases} T_{\text{setup}} = 5 \text{ ns} \\ T_{\text{hold}} = 0 \text{ ns} \\ T_p = 8 \text{ ns} \end{cases}$$

PLOGIQUE

$$\begin{cases} T_p = 10 \end{cases}$$



$$\Rightarrow \text{période minimale} = 5 + 2 \times 10 + 8 = 33 \text{ ns}$$