Compteurs synchrones

Exercice 1

1. Compteur synchrone modulo 10

Etat	Q_3	Q_2	Q_1	Q_0	J_3	K_3	J_2	K_2	J_1	K_1	J_0	K_0
0	0	0	0	0	0	x	0	x	0	x	1	x
1	0	0	0	1	0	x	0	x	1	x	x	1
2	0	0	1	0	0	x	0	x	x	0	1	x
3	0	0	1	1	0	x	1	x	x	1	x	1
4	0	1	0	0	0	x	x	0	0	x	1	x
5	0	1	0	1	0	x	x	0	1	x	x	1
6	0	1	1	0	0	x	x	0	x	0	1	x
7	0	1	1	1	1	x	x	1	x	1	x	1
8	1	0	0	0	x	0	0	x	0	x	1	x
9	1	0	0	1	x	1	0	x	0	x	x	1
0	0	0	0	0								

A partir de la table (Q_0, J_0, K_0) on peut tirer $J_0 = K_0 = 1$

Q_3Q_2 \ Q_1Q_0	00	01	11	10
00	0	1	3	2
01	4	5	7	6
11	12	13	15	14
10	8	9	11	10

Les cases 10 à 15 ne sont pas utilisées (compteur modulo 10).
On peut, donc, les remplir par des **x**.

Q_3Q_2 \ Q_1Q_0	00	01	11	10
00				
01				
11	x	x	x	x
10			x	x

J_1

Q_3Q_2 \ Q_1Q_0	00	01	11	10
00	0	1	x	x
01	0	1	x	x
11	x	x	x	x
10	0	0	x	x

$J_1 = \overline{Q}_3 Q_0$

K_1

Q_3Q_2 \ Q_1Q_0	00	01	11	10
00	0	1	x	x
01	0	1	x	x
11	x	x	x	x
10	0	0	x	x

$K_1 = \overline{Q}_3 Q_0$

J_2

Q_3Q_2 \ Q_1Q_0	00	01	11	10
00	0	0	1	0
01	x	x	x	x
11	x	x	x	x
10	0	0	x	x

$J_2 = Q_1Q_0$

K_2

Q_3Q_2 \ Q_1Q_0	00	01	11	10
00	x	x	x	x
01	0	0	1	0
11	x	x	x	x
10	0	0	x	x

$K_2 = Q_1Q_0$

J_3

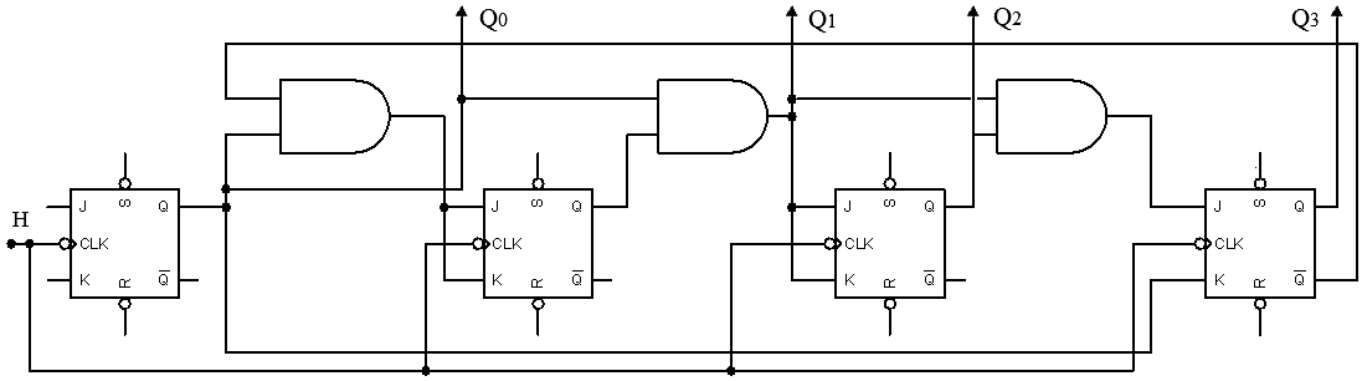
Q_3Q_2 \ Q_1Q_0	00	01	11	10
00	0	0	0	0
01	0	0	1	0
11	x	x	x	x
10	x	x	x	x

$J_3 = Q_2Q_1Q_0$

K_3

Q_3Q_2 \ Q_1Q_0	00	01	11	10
00	x	x	x	x
01	x	x	x	x
11	x	x	x	x
10	0	1	x	x

$K_3 = Q_0$



2. Compteur synchrone qui compte de la façon suivante :

$\rightarrow 0 \rightarrow 3 \rightarrow 5 \rightarrow 7 \rightarrow 10 \rightarrow 12 \rightarrow$

Q_3	Q_2	Q_1	Q_0	J_3	K_3	J_2	K_2	J_1	K_1	J_0	K_0
0	0	0	0	0	x	0	x	1	x	1	x
0	0	1	1	0	x	1	x	x	1	x	0
0	1	0	1	0	x	x	0	1	x	x	0
0	1	1	1	1	x	x	1	x	0	x	1
1	0	1	0	x	0	1	x	x	1	0	x
1	1	0	0	x	1	x	1	0	x	0	x

J_0

Q_3Q_2 \ Q_1Q_0	00	01	11	10
00	1	x	x	x
01	x	x	x	x
11	0	x	x	x
10	x	x	x	0

$J_0 = \overline{Q}_3$

K_0

Q_3Q_2 \ Q_1Q_0	00	01	11	10
00	x	x	0	x
01	x	0	1	x
11	x	x	x	x
10	x	x	x	x

$K_0 = Q_1Q_2$

J_1

Q_3Q_2 \ Q_1Q_0	00	01	11	10
00	1	x	x	x
01	x	1	x	x
11	0	x	x	x
10	x	x	x	x

$J_1 = \overline{Q}_3$

K_1

Q_3Q_2 \ Q_1Q_0	00	01	11	10
00	x	x	1	x
01	x	x	0	x
11	x	x	x	x
10	x	x	x	1

$K_1 = \overline{Q}_2$

J_2

Q_3Q_2 \ Q_1Q_0	00	01	11	10
00	0	x	1	x
01	x	x	x	x
11	x	x	x	x
10	x	x	x	1

$J_2 = Q_1$

K_2

Q_3Q_2 \ Q_1Q_0	00	01	11	10
00	x	x	x	x
01	x	0	1	x
11	1	x	x	x
10	x	x	x	x

$K_2 = Q_1 + Q_3$

J_3

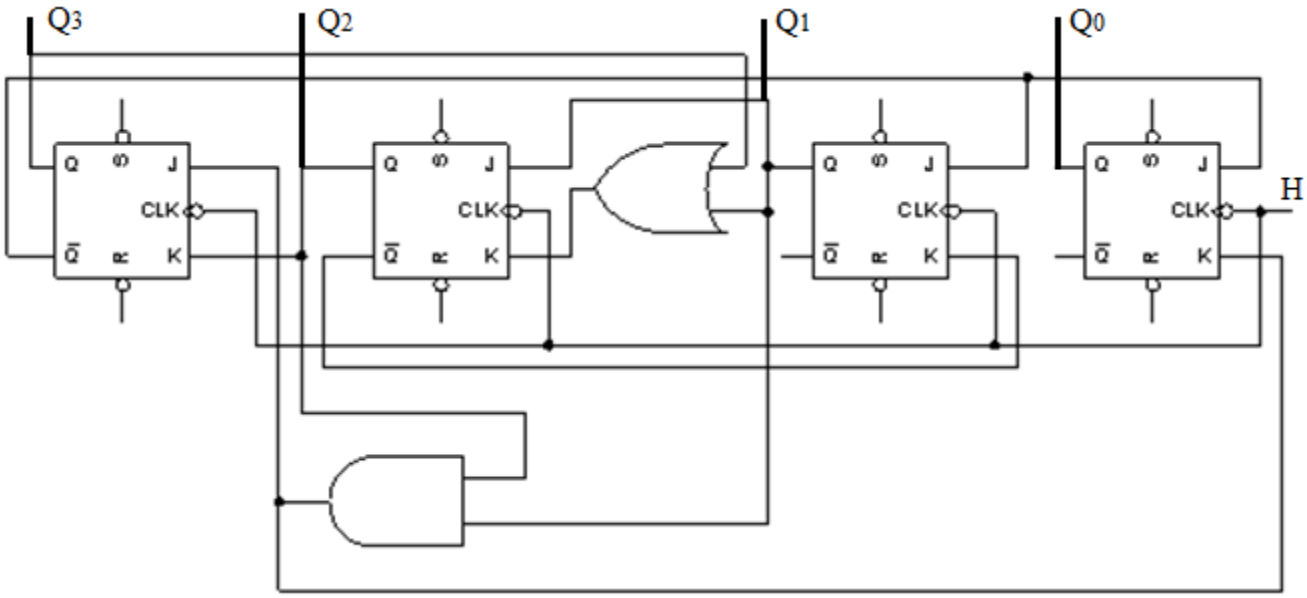
Q_3Q_2 \ Q_1Q_0	00	01	11	10
00	0	x	0	x
01	x	0	1	x
11	x	x	x	x
10	x	x	x	x

$J_3 = Q_1Q_2$

K_3

Q_3Q_2 \ Q_1Q_0	00	01	11	10
00	x	x	x	x
01	x	x	x	x
11	1	x	x	x
10	x	x	x	0

$K_3 = Q_2$



Exercice 2

1. Compteur synchrone modulo 8 à base des bascules D

Etat	Q_2	Q_1	Q_0		D_2	D_1	D_0
0	0	0	0		0	0	1
1	0	0	1		0	1	0
2	0	1	0		0	1	1
3	0	1	1		1	0	0
4	1	0	0		1	0	1
5	1	0	1		1	1	0
6	1	1	0		1	1	1
7	1	1	1		0	0	0
0	0	0	0				

Q_2 \ Q_1Q_0	00	01	11	10
0	0	1	3	2
1	4	5	7	6

Q_2 \ Q_1Q_0	00	01	11	10
0	1	0	0	1
1	1	0	0	1

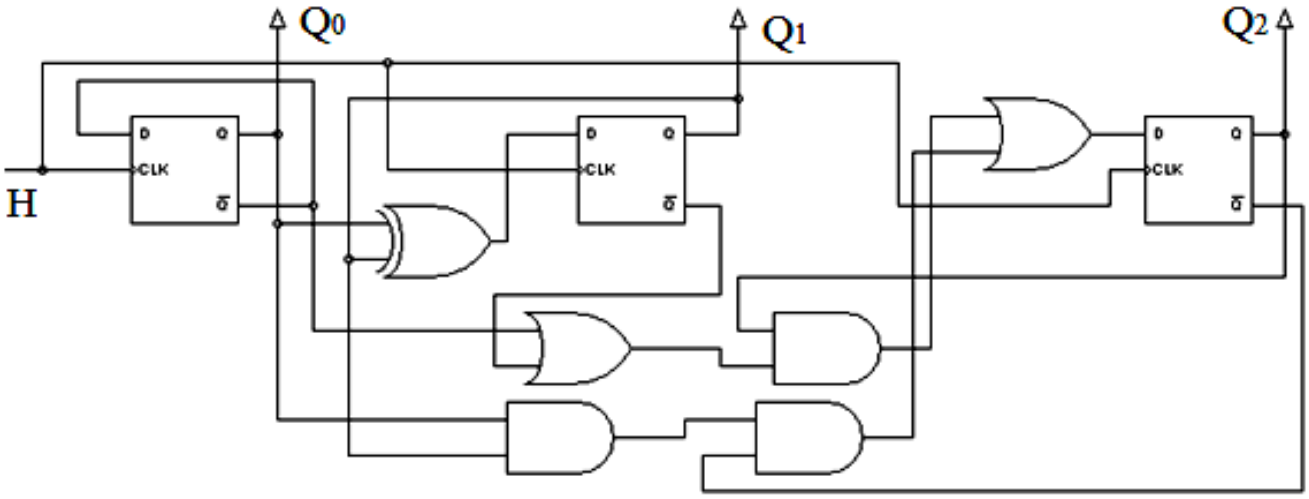
$$D_0 = \overline{Q}_0$$

Q_2 \ Q_1Q_0	00	01	11	10
0	0	1	0	1
1	0	1	0	1

$$D_1 = \bar{Q}_0 Q_1 + Q_0 \bar{Q}_1$$

Q_2 \ Q_1Q_0	00	01	11	10
0	0	0	1	0
1	1	1	0	1

$$D_2 = \bar{Q}_0 Q_2 + \bar{Q}_1 Q_2 + Q_0 Q_1 \bar{Q}_2$$



2. Compteur synchrone : $\rightarrow 0 \rightarrow 3 \rightarrow 4 \rightarrow 7 \rightarrow$

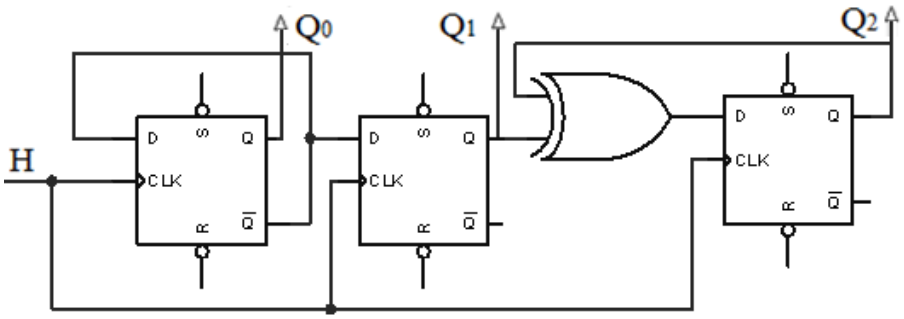
Q_2	Q_1	Q_0		D_2	D_1	D_0
0	0	0		0	1	1
0	1	1		1	0	0
1	0	0		1	1	1
1	1	1		0	0	0

Q_2 \ Q_1Q_0	00	01	11	10
0	1	x	0	x
1	1	x	0	x

$$D_0 = D_1 = \bar{Q}_0$$

Q_2 \ Q_1Q_0	00	01	11	10
0	0	x	1	x
1	1	x	0	x

$$D_2 = \bar{Q}_1 Q_2 + Q_1 \bar{Q}_2 = Q_2 \oplus Q_1$$



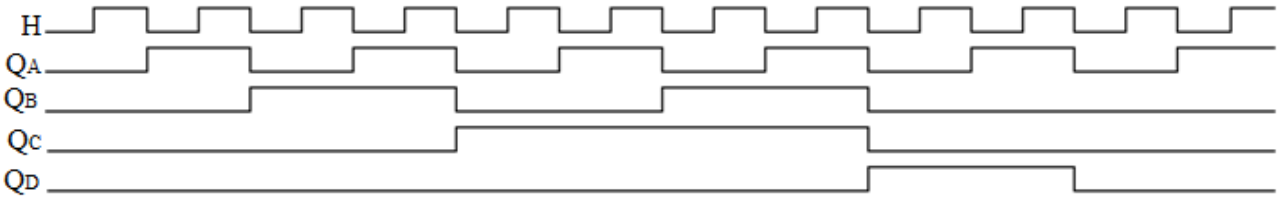
Exercice 3

1. $J_A = K_A = 1$ $\quad J_B = K_B = \overline{\overline{Q_A} + Q_D}$

$J_C = K_C = Q_A Q_B$ $\quad J_D = \overline{\overline{Q_A Q_B} + \overline{Q_C}}$ $\quad K_D = Q_A$

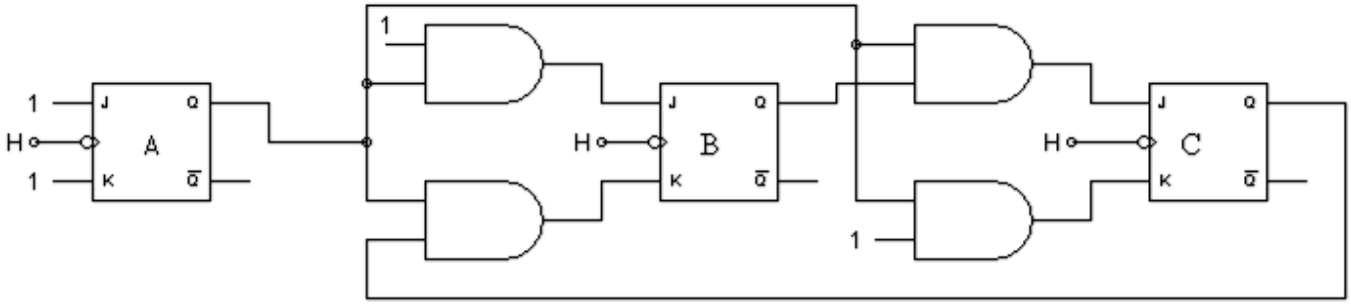
2.

Etat	Q_D	Q_C	Q_B	Q_A		J_D	K_D		J_C	K_C		J_B	K_B		J_A	K_A
0	0	0	0	0		0	0		0	0		0	0		1	1
1	0	0	0	1		0	1		0	0		1	1		1	1
2	0	0	1	0		0	0		0	0		0	0		1	1
3	0	0	1	1		0	1		1	1		1	1		1	1
4	0	1	0	0		0	0		0	0		0	0		1	1
5	0	1	0	1		0	1		0	0		1	1		1	1
6	0	1	1	0		0	0		0	0		0	0		1	1
7	0	1	1	1		1	1		1	1		1	1		1	1
8	1	0	0	0		0	0		0	0		0	0		1	1
9	1	0	0	1		0	1		0	0		0	0		1	1
0	0	0	0	0												



3. Le tableau montre que le modulo de ce compteur est 10.

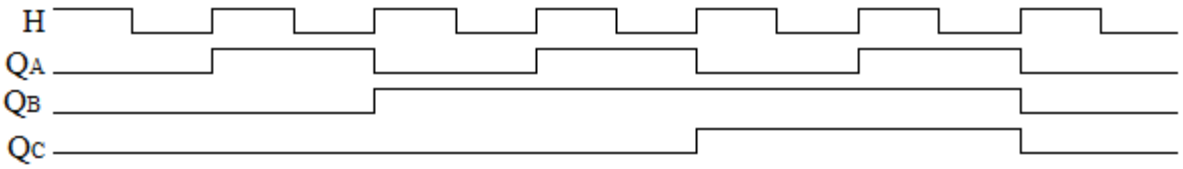
Exercice 4



1. $J_A = K_A = 1$ $J_B = Q_A$ $K_B = Q_A Q_C$ $J_C = Q_A Q_B$ $K_C = Q_A$

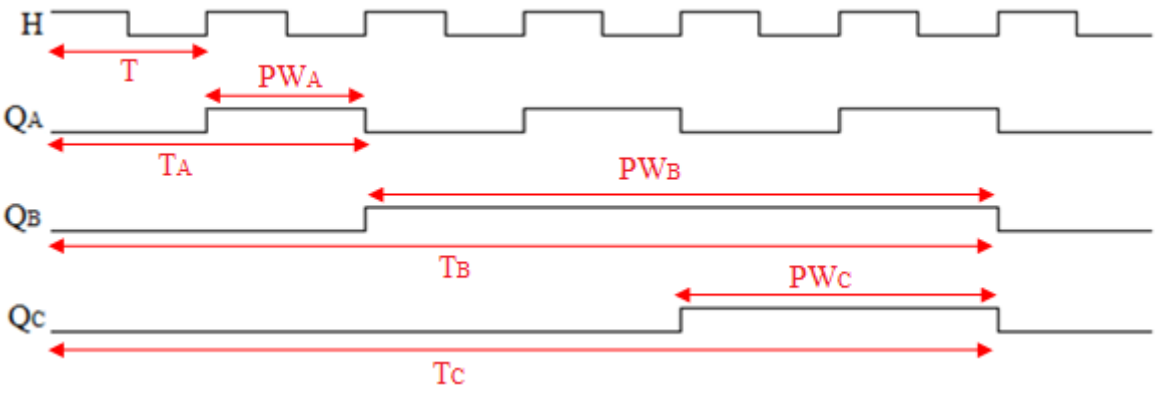
2.

Etat	Q_C	Q_B	Q_A		J_C	K_C		J_B	K_B		J_A	K_A
0	0	0	0		0	0		0	0		1	1
1	0	0	1		0	1		1	0		1	1
2	0	1	0		0	0		0	0		1	1
3	0	1	1		1	1		1	0		1	1
6	1	1	0		0	0		0	0		1	1
7	1	1	1		1	1		1	1		1	1
0	0	0	0									



3. Ce compteur réalise la séquence suivante : $\rightarrow 0 \rightarrow 1 \rightarrow 2 \rightarrow 3 \rightarrow 6 \rightarrow 7 \rightarrow$

4.



$T_A = 2 \times T$ $T_B = 6 \times T$ $T_C = 6 \times T$

$f_H = 1 / T$

$f_A = 1 / T_A = 1 / 2 \times T = f_H / 2$

$f_B = 1 / T_B = 1 / 6 \times T = f_H / 6$

$f_C = 1 / T_C = 1 / 6 \times T = f_H / 6$

$PW_A = T$ $PW_B = 4 \times T$ $PW_C = 2 \times T$

$\alpha_A = PW_A / T_A = T / T_A = 1 / 2$

$\alpha_B = PW_B / T_B = 4 \times T / 6 \times T = 4 / 6 = 2 / 3$

$\alpha_C = PW_C / T_C = 2 \times T / 6 \times T = 2 / 6 = 1 / 3$

Fréquence	Rapport cyclique
$f_C = f_H / 6$	$\alpha_C = 1 / 3 = 0,33$
$f_B = f_H / 6$	$\alpha_B = 2 / 3 = 0,66$
$f_A = f_H / 2$	$\alpha_A = 1 / 2 = 0,5$