

# TD3: Archi

## Bascule D

| D | H | $Q_n$     | $\overline{Q_n}$     |
|---|---|-----------|----------------------|
| 0 | ↑ | 0         | 1                    |
| 1 | ↑ | 1         | 0                    |
| X | 0 | $Q_{n-1}$ | $\overline{Q_{n-1}}$ |
| X | 1 | $Q_{n-1}$ | $\overline{Q_{n-1}}$ |

Table de fonctionnement de la bascule D

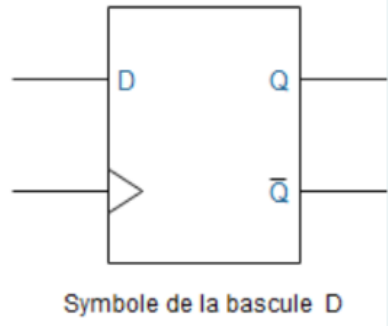


Figure 5

### Exercice 1

En utilisant les bascules D synchrones à front montant d'horloge, étudier et donner les schémas des compteurs suivants:

1. Compteur synchrone modulo 8
2. Compteur synchrone qui compte de la façon suivante:  $0 \rightarrow 3 \rightarrow 4 \rightarrow 7 \rightarrow 0 \dots$

| N | $Q_2$ | $Q_1$ | $Q_0$ | $D_2$ | $D_1$ | $D_0$ |   |
|---|-------|-------|-------|-------|-------|-------|---|
| 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     | ↑ |

$D_0$

| $Q_2 \backslash Q_1 Q_0$ | 00 | 01 | 11 | 10 |
|--------------------------|----|----|----|----|
| 0                        | 1  | 0  | 0  | 1  |
| 1                        | 1  | 0  | 0  | 1  |

$D_0 = \overline{Q_0}$

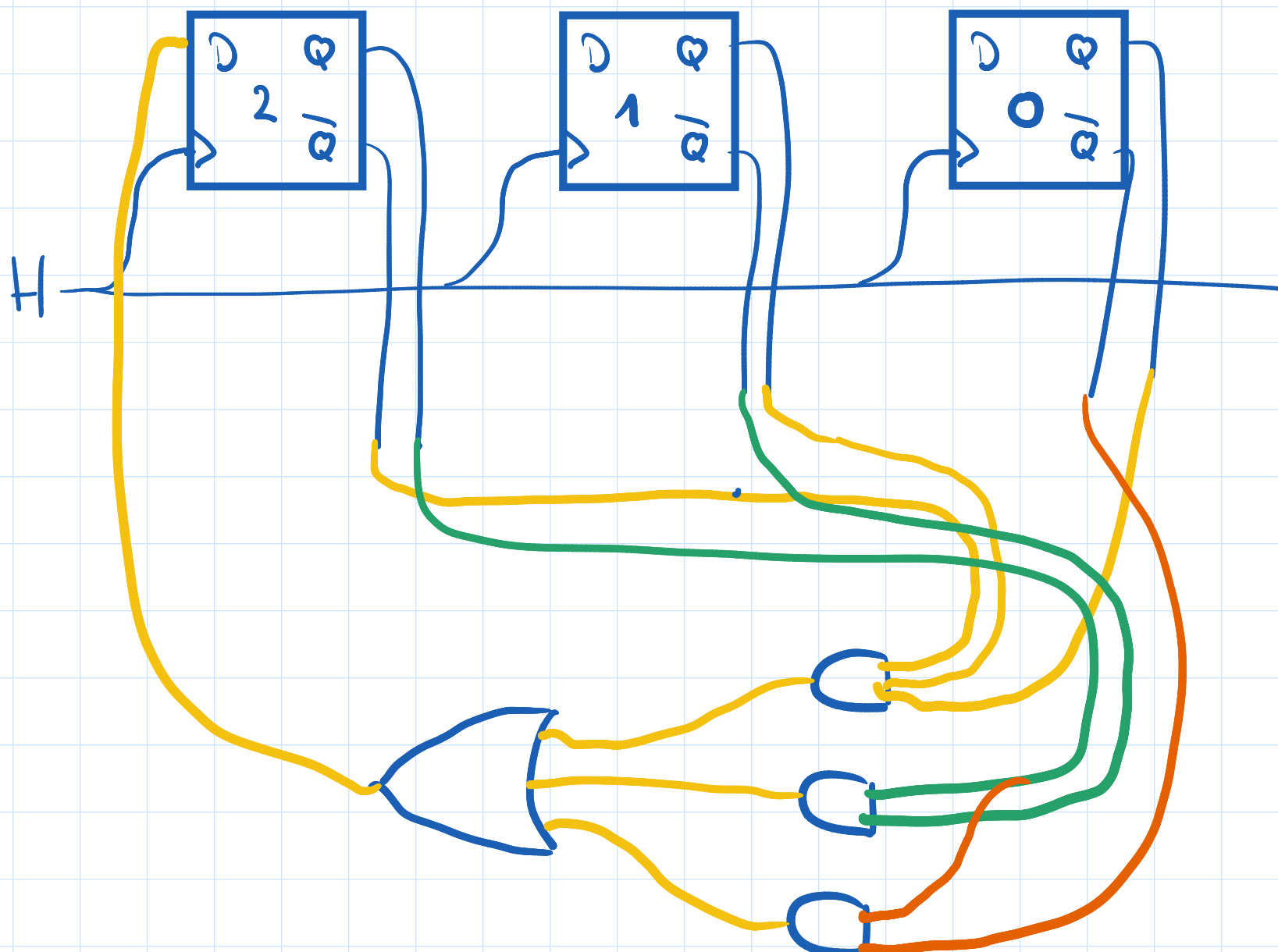
$D_1$

| $Q_2 \backslash Q_1 Q_0$ | 00 | 01 | 11 | 10 |
|--------------------------|----|----|----|----|
| 0                        | 0  | 1  | 0  | 1  |
| 1                        | 0  | 1  | 0  | 1  |

$D_1 = \overline{Q_1}Q_0 + Q_1\overline{Q_0} = Q_0 \oplus Q_1$

$$D_2 = \overline{Q_2}Q_1Q_0 + Q_2\overline{Q_1} + Q_2\overline{Q_0}$$

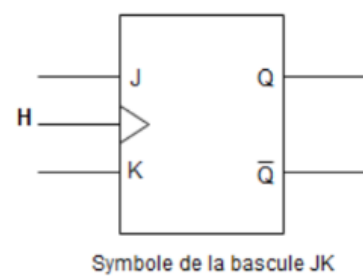
| $Q_2 \backslash Q_1 Q_0$ | 00 | 01 | 11 | 10 |
|--------------------------|----|----|----|----|
| 0                        | 0  | 0  | 1  | 0  |
| 1                        | 1  | 1  | 0  | 1  |



# Bascule JK.

| K | J | H   | $Q_n$                | $Q_n$ | $Q_{n+1}$ | J | K |
|---|---|-----|----------------------|-------|-----------|---|---|
| x | x | 0 ↓ | $Q_{n-1}$            | 0     | 0         | 0 | x |
| 0 | 0 | ↑   | $Q_{n-1}$            | 0     | 1         | 1 | x |
| 0 | 1 | ↑   | 1                    | 1     | 0         | x | 1 |
| 1 | 0 | ↑   | 0                    | 1     | 1         | x | 0 |
| 1 | 1 | ↑   | $\overline{Q_{n-1}}$ |       |           |   |   |

| J | K | H | $Q_n$                | $\overline{Q_n}$     | Fonctionnement |
|---|---|---|----------------------|----------------------|----------------|
| x | x | ↓ | $Q_{n-1}$            | $\overline{Q_{n-1}}$ | Mémoire        |
| 0 | 0 | ↑ | $Q_{n-1}$            | $\overline{Q_{n-1}}$ | Mémoire        |
| 1 | 0 | ↑ | 1                    | 0                    | Set            |
| 0 | 1 | ↑ | 0                    | 1                    | Reset          |
| 1 | 1 | ↑ | $\overline{Q_{n-1}}$ | $Q_{n-1}$            | Toggle         |



Symbole de la bascule JK

Table de fonctionnement de la bascule JK

Figure 6

## Exercice 2

En utilisant les bascules JK, étudier et donner les schémas des compteurs suivants:

1. Compteur synchrone modulo 10

2. Compteur synchrone qui compte de la façon suivante:  $\rightarrow 0 \rightarrow 3 \rightarrow 5 \rightarrow 7 \rightarrow 10 \rightarrow 12 \rightarrow 0$

| N  | $Q_3$ | $Q_2$ | $Q_1$ | $Q_0$ | $J_3$ | $K_3$ | $J_2$ | $K_2$ | $J_1$ | $K_1$ | $J_0$ | $K_0$ |
|----|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| 0  | 0     | 0     | 0     | 0     | 0     | x     | 0     | x     | 1     | x     | 1     | x     |
| 3  | 0     | 0     | 1     | 1     | 0     | x     | 1     | x     | x     | 1     | x     | 0     |
| 5  | 0     | 1     | 0     | 1     | 0     | x     | x     | 0     | 1     | x     | x     | 0     |
| 7  | 0     | 1     | 1     | 1     | 1     | x     | x     | 1     | x     | 0     | x     | 1     |
| 10 | 1     | 0     | 1     | 0     | x     | 0     | 1     | x     | x     | 1     | 0     | x     |
| 12 | 1     | 1     | 0     | 0     | x     | 1     | x     | 1     | 0     | x     | 0     | x     |

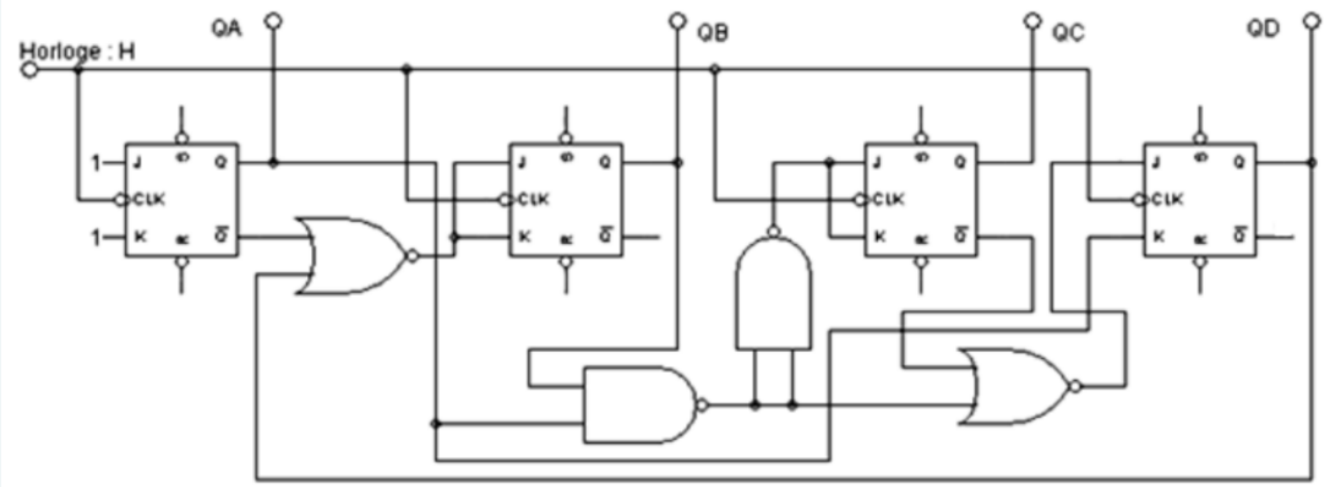
$$J_0 = \overline{Q_3}$$

| $Q_3 Q_2 \backslash Q_1 Q_0$ | 00 | 01 | 11 | 10 |
|------------------------------|----|----|----|----|
| 00                           | 1  | x  | x  | x  |
| 01                           | x  | x  | x  | x  |
| 11                           | 0  | x  | x  | x  |
| 10                           | x  | x  | x  | 0  |

$$K_0 = Q_2 Q_1$$

| $Q_3 Q_2 \backslash Q_1 Q_0$ | 00 | 01 | 11 | 10 |
|------------------------------|----|----|----|----|
| 00                           | x  | x  | 0  | x  |
| 01                           | x  | 0  | 1  | x  |
| 11                           | x  | x  | x  | x  |
| 10                           | x  | x  | x  | x  |

Exercice 3



1. Déterminer les équations des entrées J et K des bascules.

2. On suppose que le compteur part de l'état QD QC QB QA= 0000. Compléter le tableau de vérité et tracer les chronogrammes de l'horloge H et des sorties QA, QB, QC et QD.

$$J_A = K_A = \underline{1}$$

$$J_B = K_B = \overline{Q_A} + Q_D = \underline{Q_A \overline{Q_D}}$$

$$J_C = K_C = \overline{Q_A Q_B} \cdot \overline{Q_A Q_B} = \underline{Q_A Q_B}$$

$$J_D = \overline{Q_C} + (Q_B Q_A) = \underline{Q_C \cdot (\overline{Q_D} + \overline{Q_A}) = Q_C Q_B Q_A.}$$

$$K_D = \underline{Q_A.}$$

| N | Q <sub>D</sub> | Q <sub>C</sub> | Q <sub>B</sub> | Q <sub>A</sub> | J <sub>D</sub> | K <sub>D</sub> | J <sub>C</sub> | K <sub>C</sub> | J <sub>B</sub> | K <sub>B</sub> | J <sub>A</sub> | K <sub>A</sub> |
|---|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|----------------|
| 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              |
| ⋮ | -              | -              | -              |                | ⋮              | ⋮              | ⋮              | ⋮              | ⋮              | ⋮              | -              | -              |
| ⋮ |                | ⋮              |                |                | ⋮              | ⋮              | ⋮              | ⋮              | ⋮              | ⋮              | ⋮              | ⋮              |
| ⋮ |                | ⋮              |                |                | ⋮              | ⋮              | ⋮              | ⋮              | ⋮              | ⋮              | ⋮              | ⋮              |
| 9 | 1              | 0              | 0              | 1              |                |                |                |                |                |                |                |                |