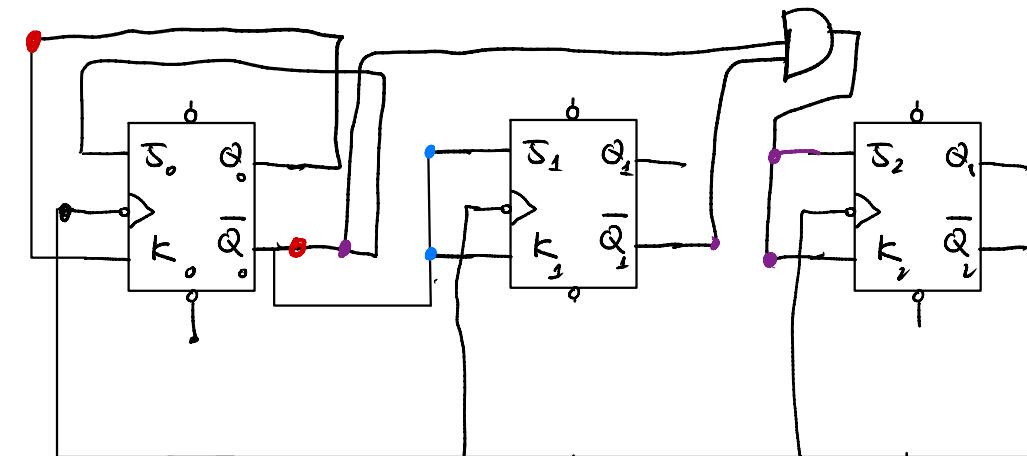
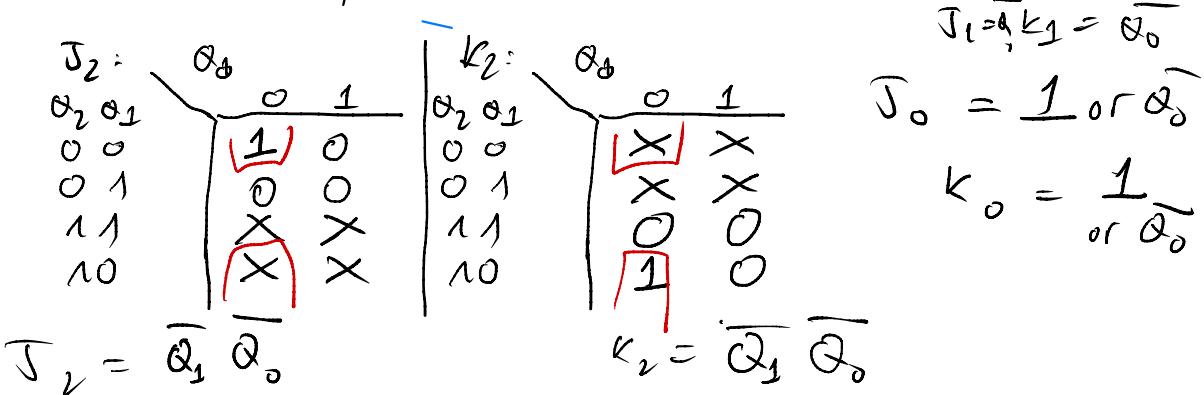


## Synchronous Counter:

Trans	Table
$0 \rightarrow 0$	0 X
$0 \rightarrow 1$	1 X
$1 \rightarrow 0$	X 1
$1 \rightarrow 1$	X 0

7 - 6 - 5 - 4 - 3 - 2 - 1 - 0 - 7 - ..

Present State	Next State	$J_2$	$K_2$	$J_1$	$K_1$	$J_0$	$K_0$
$Q_2 Q_1 Q_0$	$Q_2' Q_1' Q_0'$						
1 1 1	1 1 0	X	0	X	0	X	1
1 1 0	1 0 1	X	0	X	1	1	X
1 0 1	1 0 0	X	0	0	X	X	1
1 0 0	0 1 1	X	1	1	X	1	X
0 1 1	0 1 0	X	0	X	0	X	1
0 1 0	0 0 1	X	0	X	1	1	X
0 0 1	0 0 0	X	0	0	X	X	1
0 0 0	1 1 1	X	1	1	X	1	X



CLK

$$7 - 6 - 5 - 4 - 3 - 2 - 1 - 0 - 7 - \dots$$

$$x \rightarrow 0 \quad x \rightarrow 1$$

$$1 \rightarrow 1 \quad x \rightarrow 0$$

Present State	Next State			
$Q_2 \ Q_1 \ Q_0$	$Q_2' \ Q_1' \ Q_0'$	$J_2 \ K_2$	$J_1 \ K_1$	$J_0 \ K_0$
1 1 1	1 1 0	X 0	X 0	X 1
1 1 0	1 0 1	X 0	X 1	1 X
1 0 1	1 0 0	X 0	0 X	X 1
1 0 0	0 1 1	X 1	1 X	1 X
0 1 1	0 1 0	0 X	X 0	X 1
0 1 0	0 0 1	0 X	X 1	1 X
0 0 1	0 0 0	0 X	0 X	X 1
0 0 0	1 1 1	1 X	1 X	1 X

0 - 1 - 4		
Present state		
$Q_2$	$Q_1$	$Q_0$
0	0	0
0	0	1
1	0	0
1	1	1
1	0	1

- 7 - 5 - 0

Next state

$Q_2^+$	$Q_1^+$	$Q_0^+$
0	0	1
1	0	0
1	1	1
1	0	1
0	0	0

$J_2$	$k_2$
0	X
0	X
1	X
0	X
1	X

$J_1$	$k_1$
0	X
0	X
1	X
1	X
0	X

$J_0$	$k_0$
1	X
1	X
1	X
0	X
1	X

$J_0$	$k_0$
1	X
1	X
1	X
0	X
1	X

$J_2 = Q_0$		
$Q_2, Q_1$	$\theta_0$	0 1
0 0	0	1
0 1	X	X
1 1	X	X
1 0	X	X

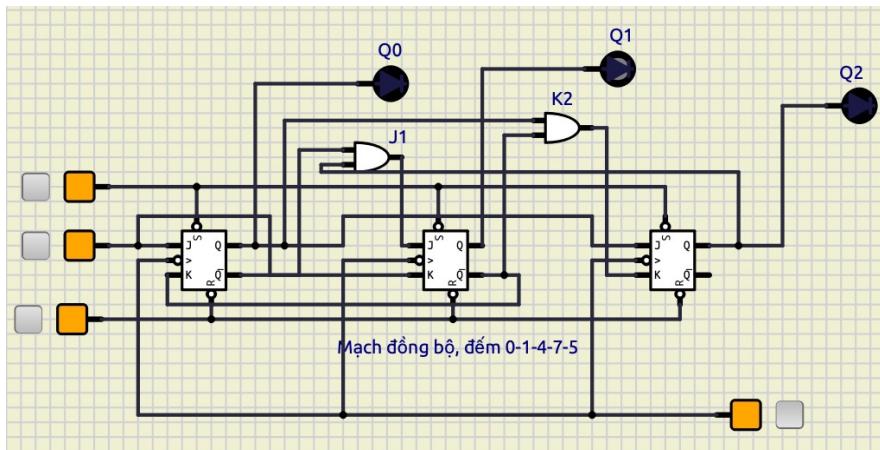
$K_L = Q_0 \cdot Q_1$		
$Q_2, Q_1$	$\theta_0$	0 1
0 0	X	X
0 1	X	X
1 1	X	X
1 0	0	1

$J_1 = \overline{Q_0} \cdot Q_2$		
$Q_2, Q_1$	$\theta_0$	0 1
0 0	0	0
0 1	X	X
1 1	X	X
1 0	1	0

$K_1 = 1$		
$Q_2, Q_1$	$\theta_0$	0 1
0 0	X	X
0 1	X	X
1 1	X	1
1 0	X	X

$J_0 = \overline{Q_1}$		
$Q_2, Q_1$	$\theta_0$	0 1
0 0	X	1
0 1	X	X
1 1	X	X
1 0	X	X

$K_0 = Q_1$		
$Q_2, Q_1$	$\theta_0$	0 1
0 0	X	1
0 1	X	X
1 1	X	0
1 0	X	1



0 - 3 - 5 - 7 - 0

Present State

Q <sub>2</sub>	Q <sub>1</sub>	Q <sub>0</sub>
0	0	0
0	1	1
1	0	1
1	1	1

Next State  
 $Q_2^+ Q_1^+ Q_0^+$

0	1	1
1	0	1
1	1	1
0	0	0

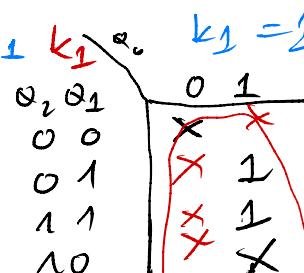
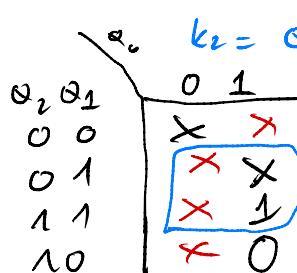
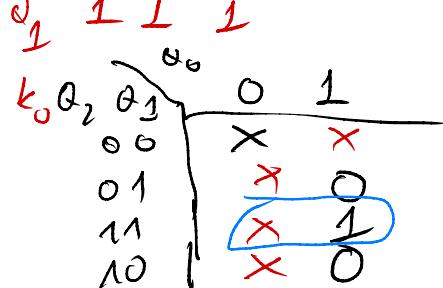
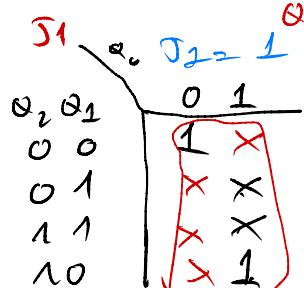
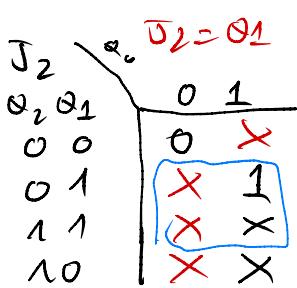
J<sub>2</sub> K<sub>2</sub>  
 $J_2$   $K_2$

0	X
1	X
X	0
X	1

J<sub>1</sub> K<sub>1</sub>  
 $J_1$   $K_1$

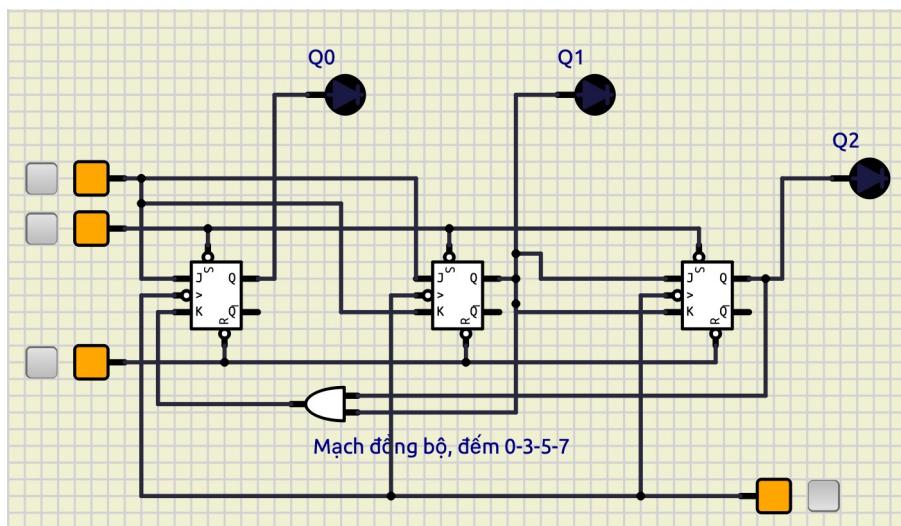
1	X
X	1
1	X
X	1

?



$K_0 = Q_2 Q_1$

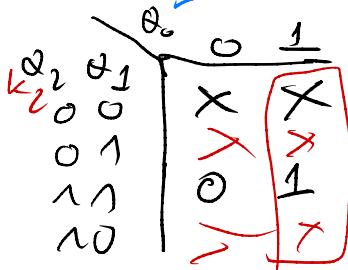
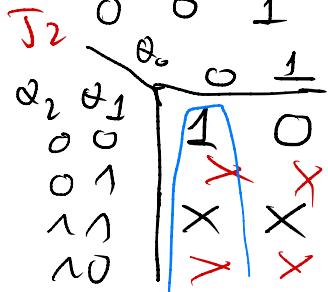
$J_0 = 1$



0 - 6 - 2 - 7 - 1 - 0

Present State

$Q_2$	$Q_1$	$Q_0$
0	0	0
1	1	0
1	1	1
0	0	1



Next State

$Q_2 + Q_1$	$Q_0$
1 1	0
1 1	1
0 0	1
0 0	0

$J_1$

$Q_2 + Q_1$	$Q_0$	$J_1$
1 1	0	0
0 0	1	X
0 1	X	X
1 1	X	X
1 0	X	X

$J_2$

$Q_2 + Q_1$	$Q_0$	$J_2$
1 1	0	X
0 0	1	X
0 1	X	X
1 1	X	X
1 0	X	X

$J_1, K_1$

$J_1$	$K_1$
1	X
X	0
X	1
0	X

$J_0$

$J_0$	$K_0$
0	X
X	X
X	0
1	X

$J_0$

$J_0$	$K_0$
0	X
0	X
0 1	X
1 1	X
1 0	X

$J_0, K_0$

$J_0$	$K_0$
0	X
X	X
X	0
1	X

$J_0$

$J_0$	$K_0$
0	X
0	X
0 1	X
1 1	X
1 0	X

$Q_2$

$Q_2$

0 - 3 - 1 - 5 - 4 - 0

Present State

$Q_2$	$Q_1$	$Q_0$
0	0	0
0	1	1
0	0	1
1	0	1
1	0	0

Next State

$Q_2^+$	$Q_1^+$	$Q_0^+$
0	1	1
0	0	1
1	0	1
1	0	0
0	0	0

$J_2$	$K_2$	$J_1$	$K_1$	$J_0$	$K_0$
0	X	1	X	1	X
0	0	X	1	X	0
1	1	0	X	0	X
1	0	X	1	0	X
0	0	X	1	0	X

$$J_2 = \overline{Q_1} Q_0$$

$Q_2$	$Q_1$	$Q_0$	$J_2$	$K_2$
0	0	0	0	1
0	1	0	X	0
1	1	0	X	X
1	0	0	X	X

$$J_1 = \overline{Q_2} \overline{Q_0}$$

$Q_2$	$Q_1$	$Q_0$	$J_1$	$K_1$
0	0	0	1	0
0	1	0	X	X
1	1	0	X	X
1	0	0	0	0

$$J_0 = \overline{Q_2}$$

$Q_2$	$Q_1$	$Q_0$	$J_0$	$K_0$
0	0	0	1	X
0	1	0	X	X
1	1	0	X	X
1	0	0	0	X

$$K_2 = \overline{Q_1} Q_0$$

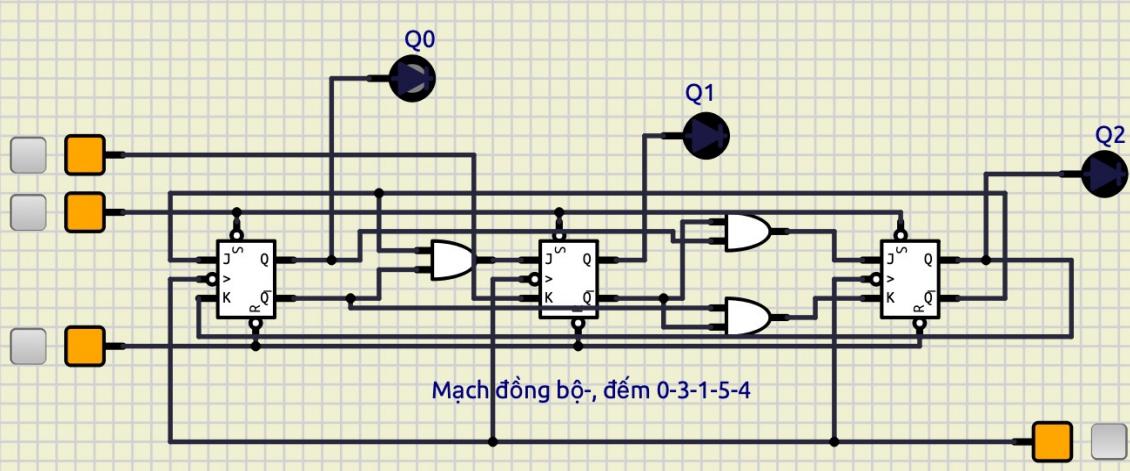
$Q_2$	$Q_1$	$Q_0$	$J_2$	$K_2$
0	0	0	X	X
0	1	0	X	X
1	1	0	X	X
1	0	0	1	0

$$K_1 = 1$$

$Q_2$	$Q_1$	$Q_0$	$J_1$	$K_1$
0	0	0	X	X
0	1	0	X	1
1	1	0	X	X
1	0	0	X	X

$$K_0 = Q_2$$

$Q_2$	$Q_1$	$Q_0$	$J_0$	$K_0$
0	0	0	X	0
0	1	0	X	0
1	1	0	X	0
1	0	0	X	1



Advantage of  $J \leftarrow FF$ : reduce logic gates