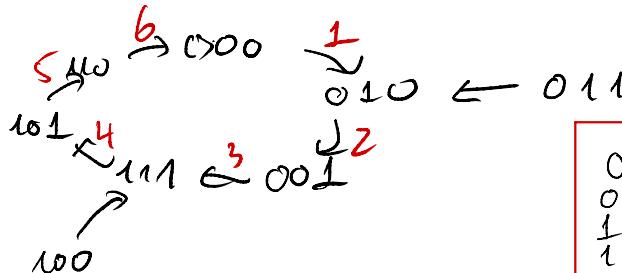


1. Design a synchronous counter using D-FF and T-K FF



2. Design a synchronous counter that have $M=8$ and count from $0 \rightarrow 5$, then repeat using D-FF.

Solution

1.

Current			Next State			Transition Table					
Q_2	Q_1	Q_0	Q_2^+	Q_1^+	Q_0^+	J_2	K_2	J_1	K_1	J_0	K_0
0	0	0	0	1	0	1	X	1	X	0	X
0	0	1	1	1	1	1	X	1	X	X	0
0	1	0	0	0	1	2	X	X	1	1	X
0	1	1	0	1	0	7	X	X	0	X	1
1	0	0	1	1	1	5	X	0	0	X	1
1	0	1	1	1	0	6	X	0	1	X	1
1	1	0	0	0	1	4	X	1	X	0	X
1	1	1	1	0	1						

$J_2 = Q_0 \cdot \bar{Q}_1$		
Q_2	Q_1	Q_0
0	0	1
0	1	0
1	1	X
1	0	X

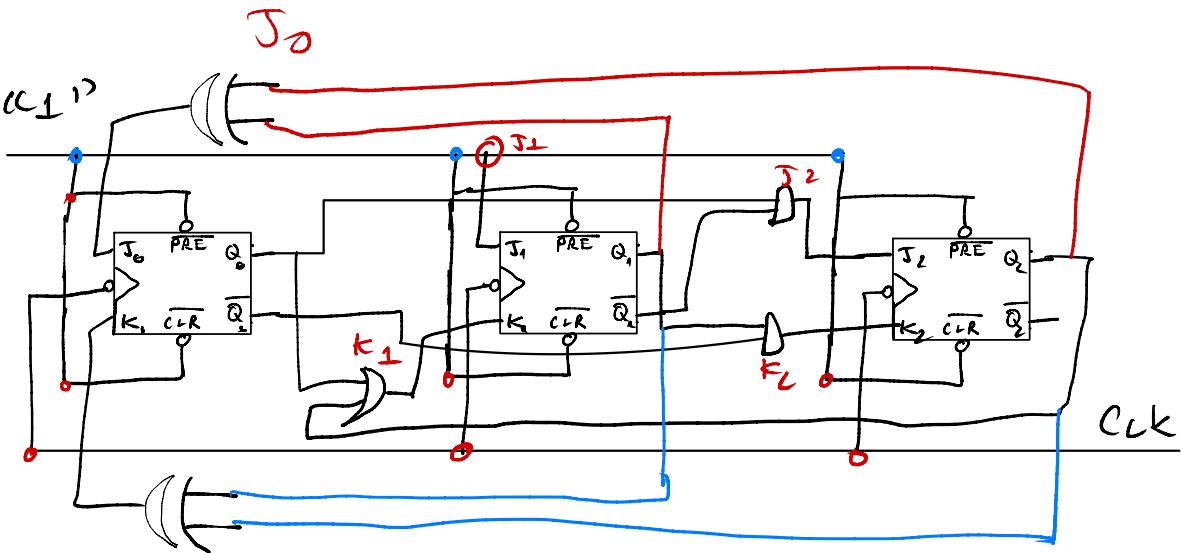
$$J_2 = 1$$

$J_0 = \bar{Q}_2 Q_1 + Q_2 \bar{Q}_1$		
Q_2	Q_1	Q_0
0	0	X
0	1	X
1	1	0
1	0	X

$K_2 = \bar{Q}_0 \cdot Q_1$		
Q_2	Q_1	Q_0
0	X	X
0	1	X
1	1	0
1	0	0

$K_1 = \bar{Q}_0 + Q_2$		
Q_2	Q_1	Q_0
0	X	X
0	1	0
1	1	1
1	0	X

$K_0 = \bar{Q}_2 Q_1 + Q_2 \bar{Q}_1$		
Q_2	Q_1	Q_0
0	X	0
0	1	X
1	1	0
1	0	X



k_0

2. Count: 0 - 1 - 2 - 3 - 4 - 5

Current $Q_2 Q_1 Q_0$	Next State $Q_2^+ Q_1^+ Q_0^+$	$J_2 \quad k_2$	$J_1 \quad k_1$	$J_0 \quad k_0$
0 0 0	0 0 1	0 X	1 X	1 X
0 0 1	0 1 0	0 X	1 X	1 X
0 1 0	0 1 1	0 X	1 X	1 X
0 1 1	1 0 0	0 X	1 X	1 X
1 0 0	1 0 1	X 0	0 X	1 X
1 0 1	0 0 0	X 1	0 X	1 X

$k_2 = Q_0$ $k_1 = Q_0$ $J_0 = 1$ $k_0 = 1$

$$J_2 = Q_1 - Q_0$$

Q_2	Q_1	Q_0	$J_2 = Q_1 - Q_0$
0	0	0	0
0	0	1	1
0	1	0	X
1	1	1	X
1	0	X	X

$$J_1 = \overline{Q_2} \cdot Q_0 \quad J_0 = 1$$

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

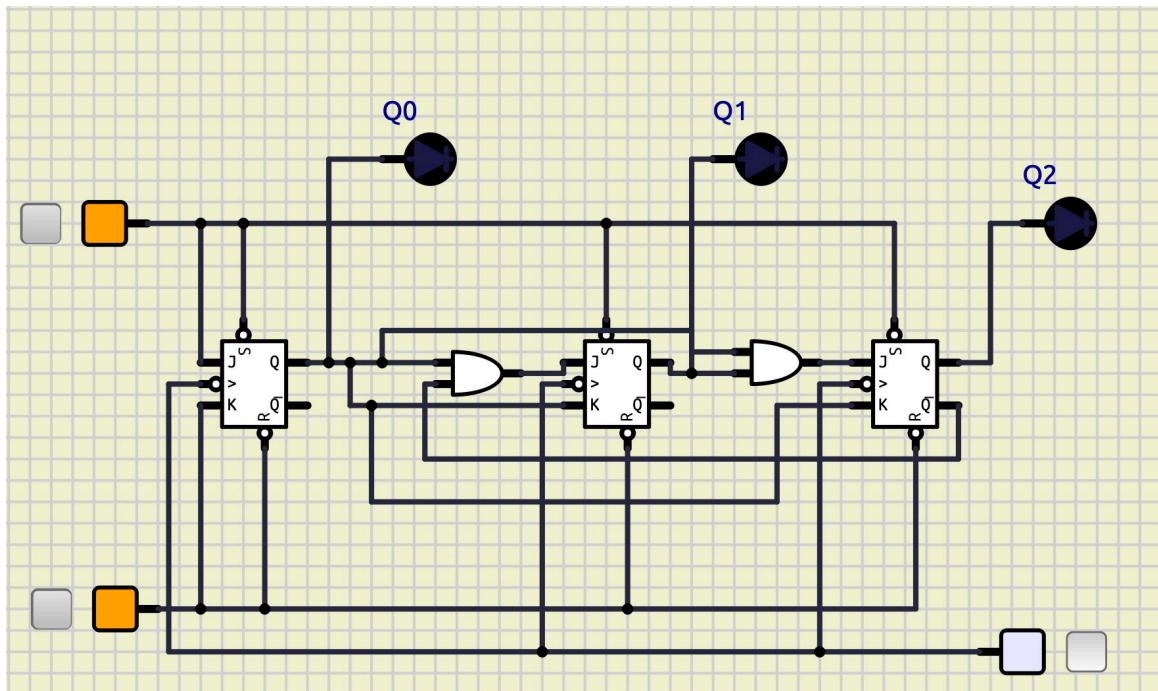
$$K_0 = 1$$

$$K_2 = Q_0$$

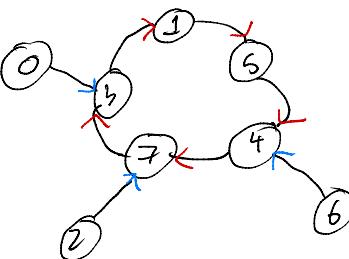
Q_2	Q_1	Q_0	$K_2 = Q_0$
0	0	X	X
0	1	X	X
1	1	X	X
1	0	0	1

$$K_1 = Q_0$$

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



Q_3 :



$$\bar{A}R + \bar{A}B$$

Current $Q_2 Q_1 Q_0$	Next State $Q_2^+ Q_1^+ Q_0^+$			Transition Table		J_0	K_0
	Q_2^+	Q_1^+	Q_0^+	J_2	K_2		
0 0 0	0	1	1	0	X	1	X
0 0 1	1	0	1	1	X	0	X
0 1 0	1	1	1	1	X	0	X
0 1 1	0	0	1	0	X	1	X
1 0 0	1	1	1	X	0	1	X
1 0 1	1	0	0	0	0	0	X
1 1 0	1	0	0	X	X	1	X
1 1 1	0	1	1	X	1	0	X

$$J_2 = \bar{Q}_0 Q_1 + Q_0 \bar{Q}_1 \quad J_1 = \bar{Q}_0 \quad J_0 = \bar{Q}_1 + \bar{Q}_2$$

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

$$k_2 = Q_0 Q_1 \quad k_1 = \bar{Q}_0 Q_2 + Q_0 \bar{Q}_2 \quad k_0 = Q_2 \bar{Q}_1$$

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

