第七章 异步时序电路

异步时序电路的分析

7.2 异步时序电路

7.2.1 异步时序电路的分析

脉冲异步时序电路的分析方法和同步时序电路类似，惟一的区别是还需考虑一个时钟方程。

1、列方程组 时钟方程、状态方程、激励方程和输出方程。

2、根据方程组列出状态转换表

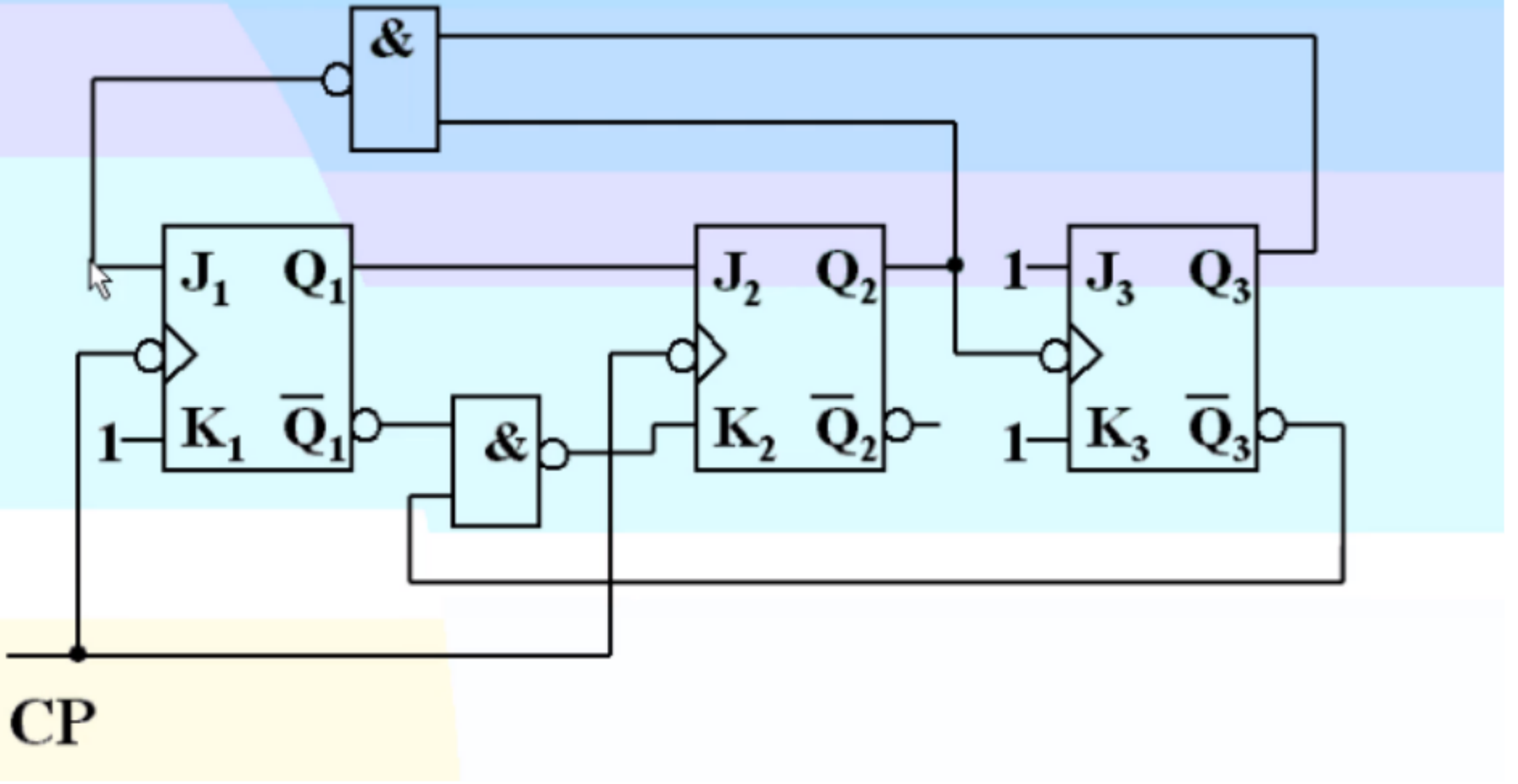
3、作出状态图

4、作出时序图(时间图、工作波形图)

5、用文字描述电路的功能

★异步时序电路分析

例1.分析图示电路

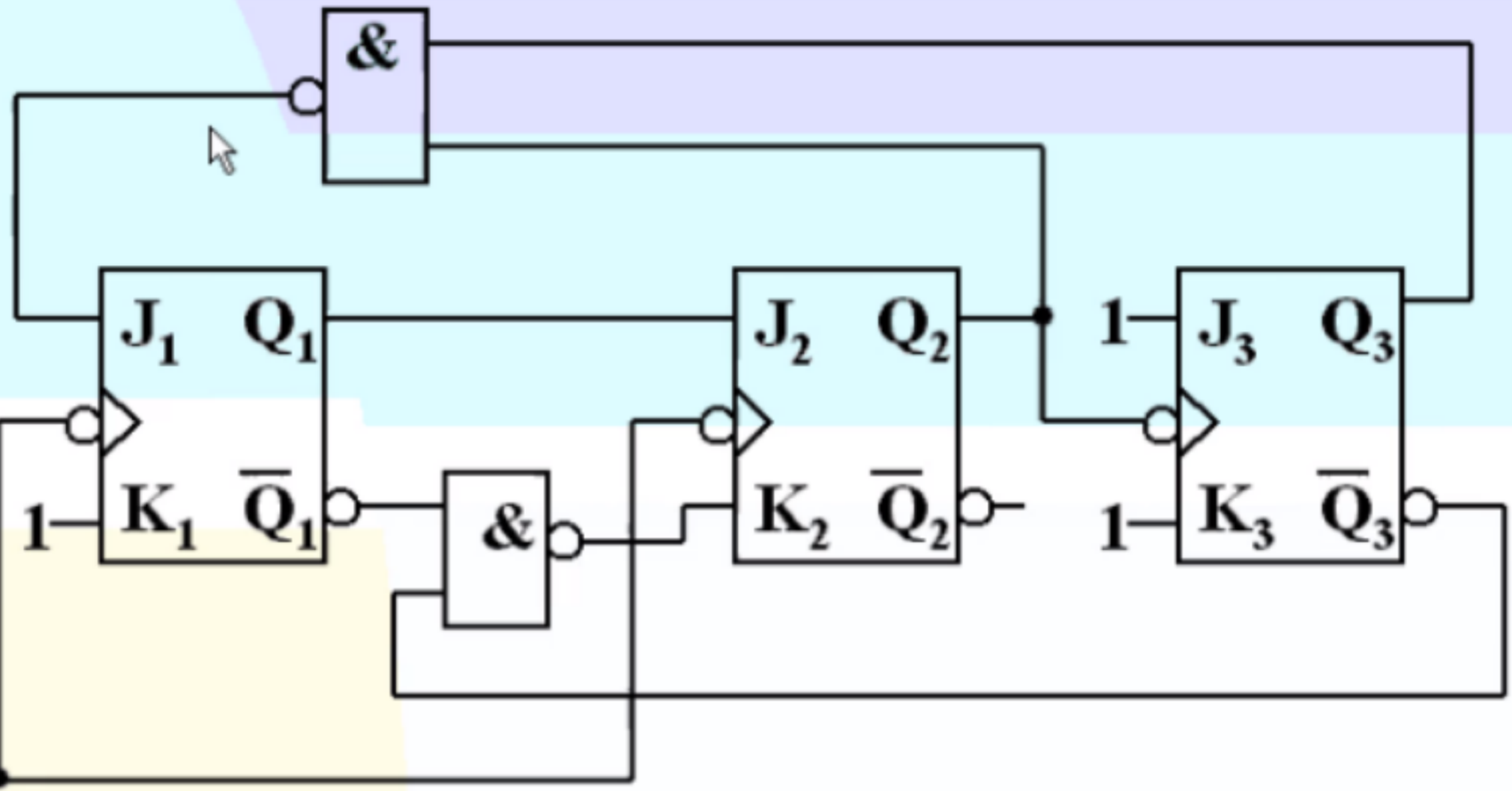


解：此为异步时序电路，Moore型。

1）时钟方程

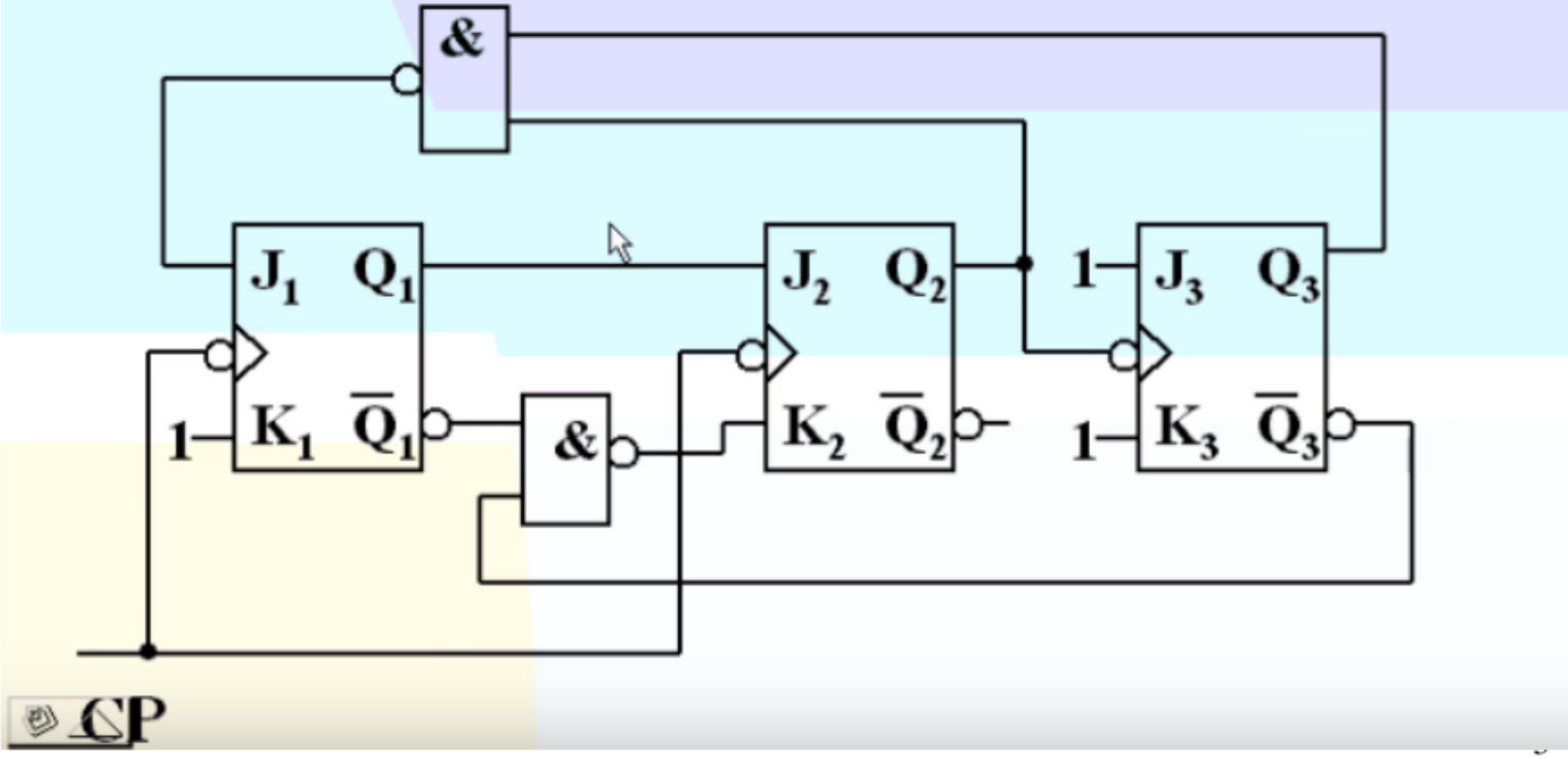
$CP_2 = CP_1 = CP$　　（外部时钟）

$CP_3 = Q_2^n$　　（Q_2^n 的↓）



2）驱动方程（输入方程）

$$\begin{cases} J_1 = \overline{Q_2^n Q_3^n} \\ K_1 = 1 \end{cases} \qquad \begin{cases} J_2 = Q_1^n \\ K_2 = \overline{\overline{Q}_1^n \, \overline{Q}_3^n} \end{cases} \qquad \begin{cases} J_3 = 1 \\ K_3 = 1 \end{cases}$$



3）状态方程

由 $Q^{n+1} = J\overline{Q}^{n} + \overline{K}Q^{n}$

得：$Q_1^{n+1} = \overline{Q_2^n Q_3^n}\ \overline{Q}_1^{n}$

$Q_2^{n+1} = Q_1^n \overline{Q}_2^{n} + \overline{Q}_1^{n}\ \overline{Q}_3^{n} Q_2^n$

$Q_3^{n+1} = \overline{Q}_3^{n} \bullet CP_3$

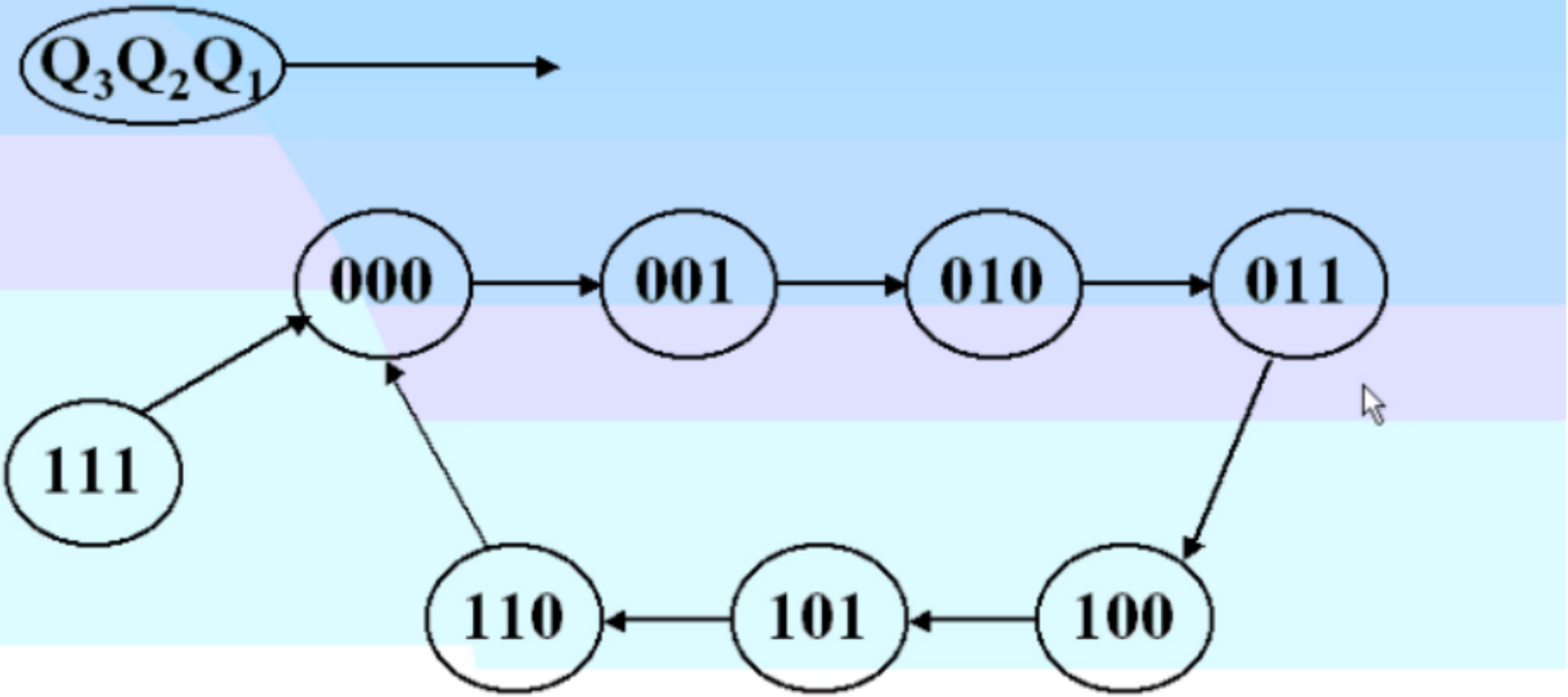
$$\begin{cases} J_1 = \overline{Q_2^n Q_3^n} \\ K_1 = 1 \end{cases} \qquad \begin{cases} J_2 = Q_1^n \\ K_2 = \overline{\overline{Q}_1^{n}\ \overline{Q}_3^{n}} \end{cases} \qquad \begin{cases} J_3 = 1 \\ K_3 = 1 \end{cases}$$

4）状态表

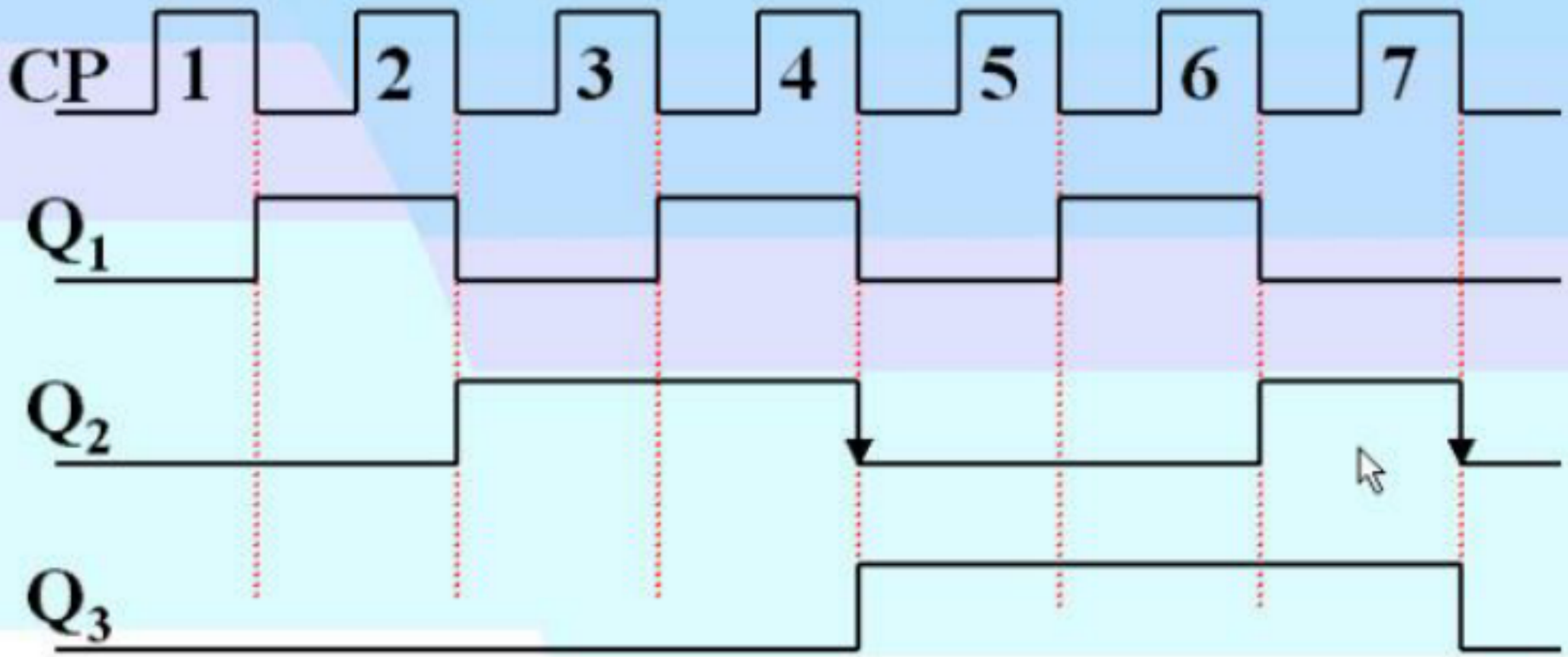
Q_3^n	Q_2^n	Q_1^n	$CP_3 = Q_2(\downarrow)$	Q_3^{n+1}	Q_2^{n+1}	Q_1^{n+1}
0	0	0	0 → 0		0	1
0	0	1	0 → 1		1	0
0	1	0	1 → 1		1	1
0	1	1	1 → 0		0	0
1	0	0	0 → 0		0	1
1	0	1	0 → 1		1	0
1	1	0	1 → 0		0	0
1	1	1	1 → 0		0	0

$$Q_1^{n+1} = \overline{Q_2^n Q_3^n}\,\overline{Q}_1^n \qquad Q_2^{n+1} = Q_1^n \overline{Q}_2^n + \overline{Q}_1^n \overline{Q}_3^n Q_2^n$$

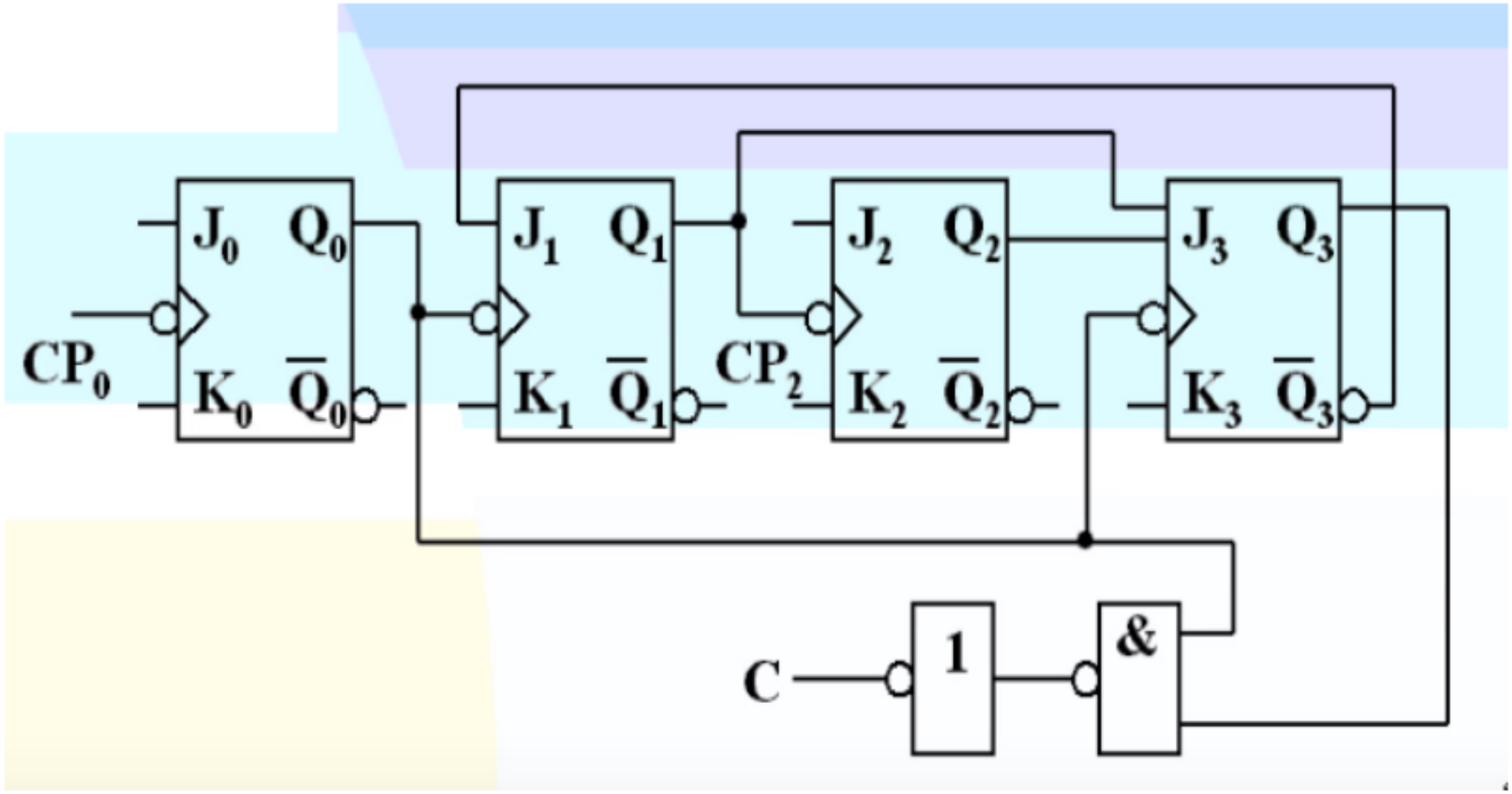
5）状态图



6）波形图



功能：具有自启动能力的异步七进制计数器。

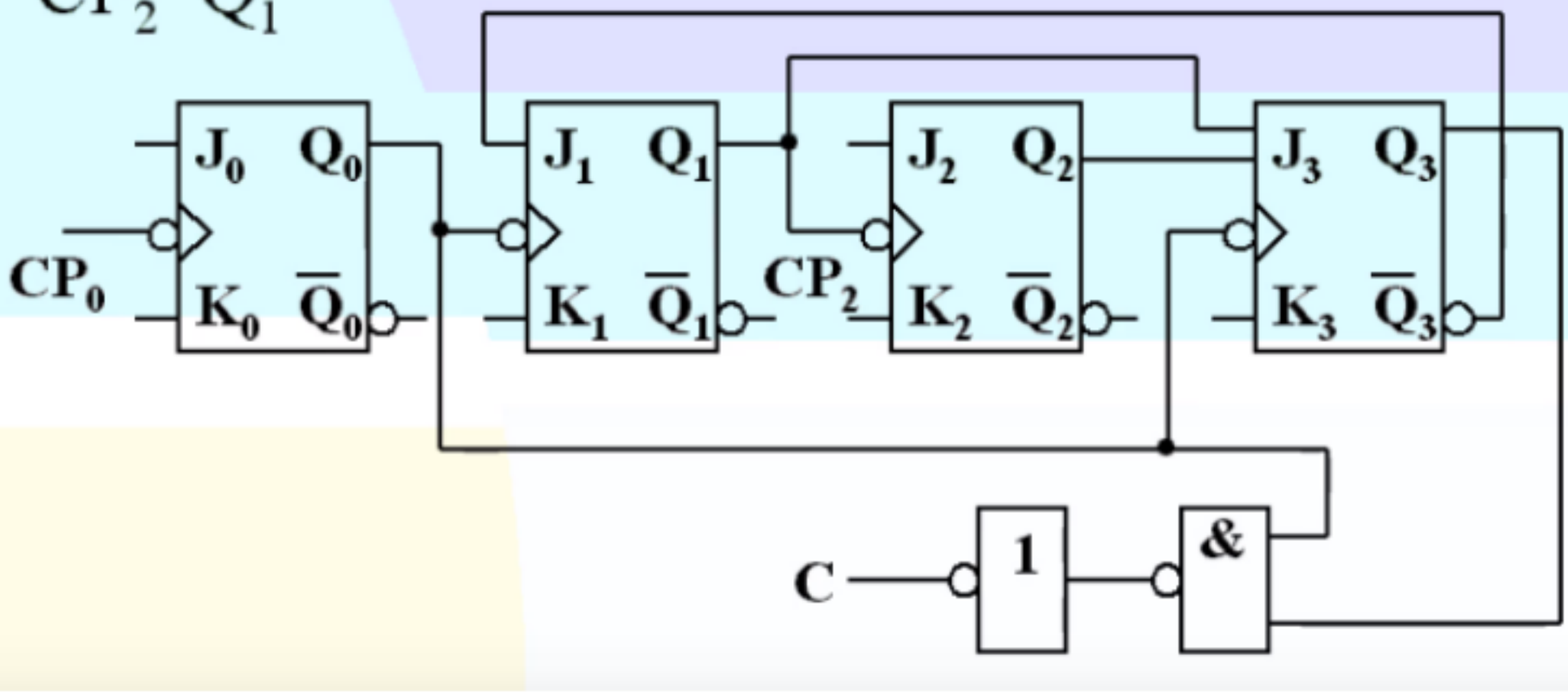

J0
Q0
CP0
K0
Q0
J1
Q1
K1
Q1
CP2
J2
Q2
K2
Q2
J3
Q3
K3
Q3
C
1
&

例2.分析图示电路。（P_{232}）

1）时钟方程

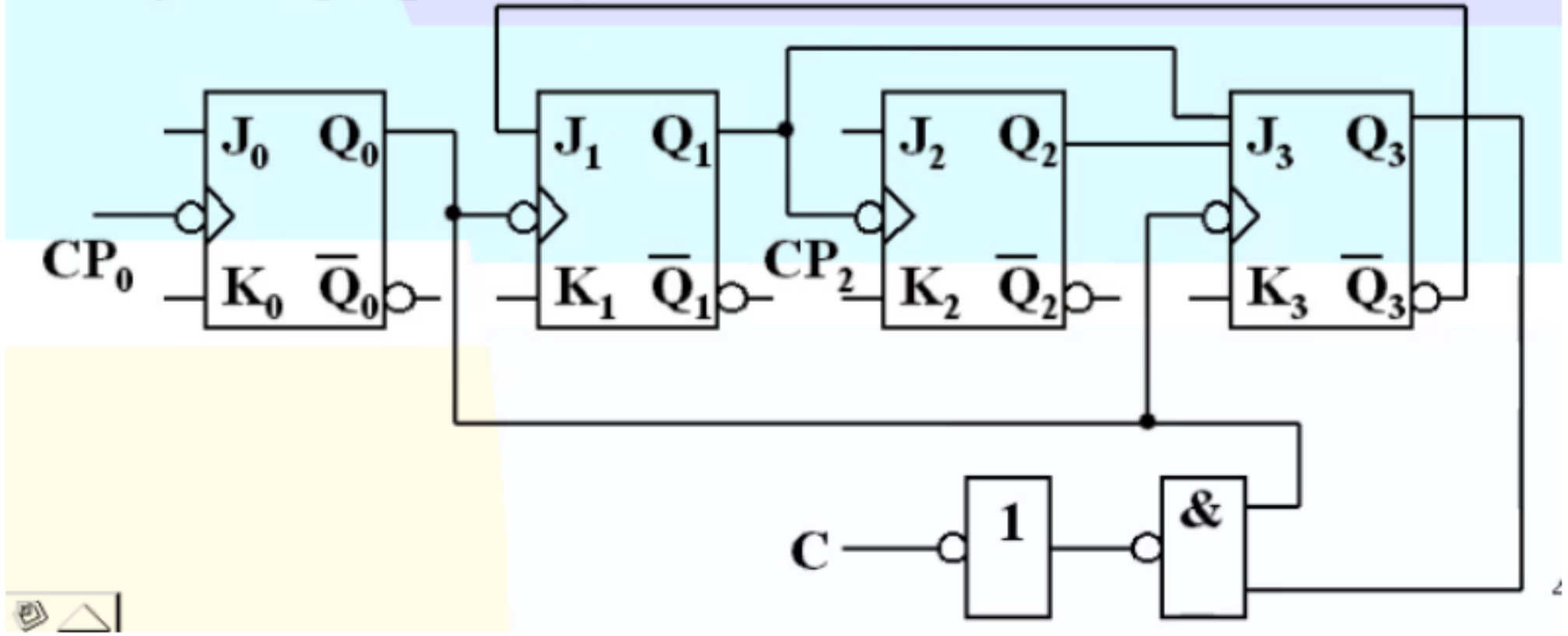
$CP_0=CP$，　$CP_1= CP_3= Q_0$

$CP_2=Q_1$



2）驱动方程（输入方程）

$$\begin{cases} J_0 = K_0 = 1 \\ J_1 = \overline{Q}_3, \quad K_1 = 1 \\ J_2 = K_2 = 1 \\ J_3 = Q_1 Q_2, \quad K_3 = 1 \end{cases}$$



3）输出方程

$$C = Q_3 Q_0$$

4）状态方程

由 $Q^{n+1} = J\overline{Q}^{n} + \overline{K}Q^{n}$

得：

$$Q_0^{n+1} = \overline{Q}_0 \bullet CP_0$$

$$Q_1^{n+1} = \overline{Q}_3\ \overline{Q}_1 \bullet CP_1$$

$$Q_2^{n+1} = \overline{Q}_2^{n} \bullet CP_2$$

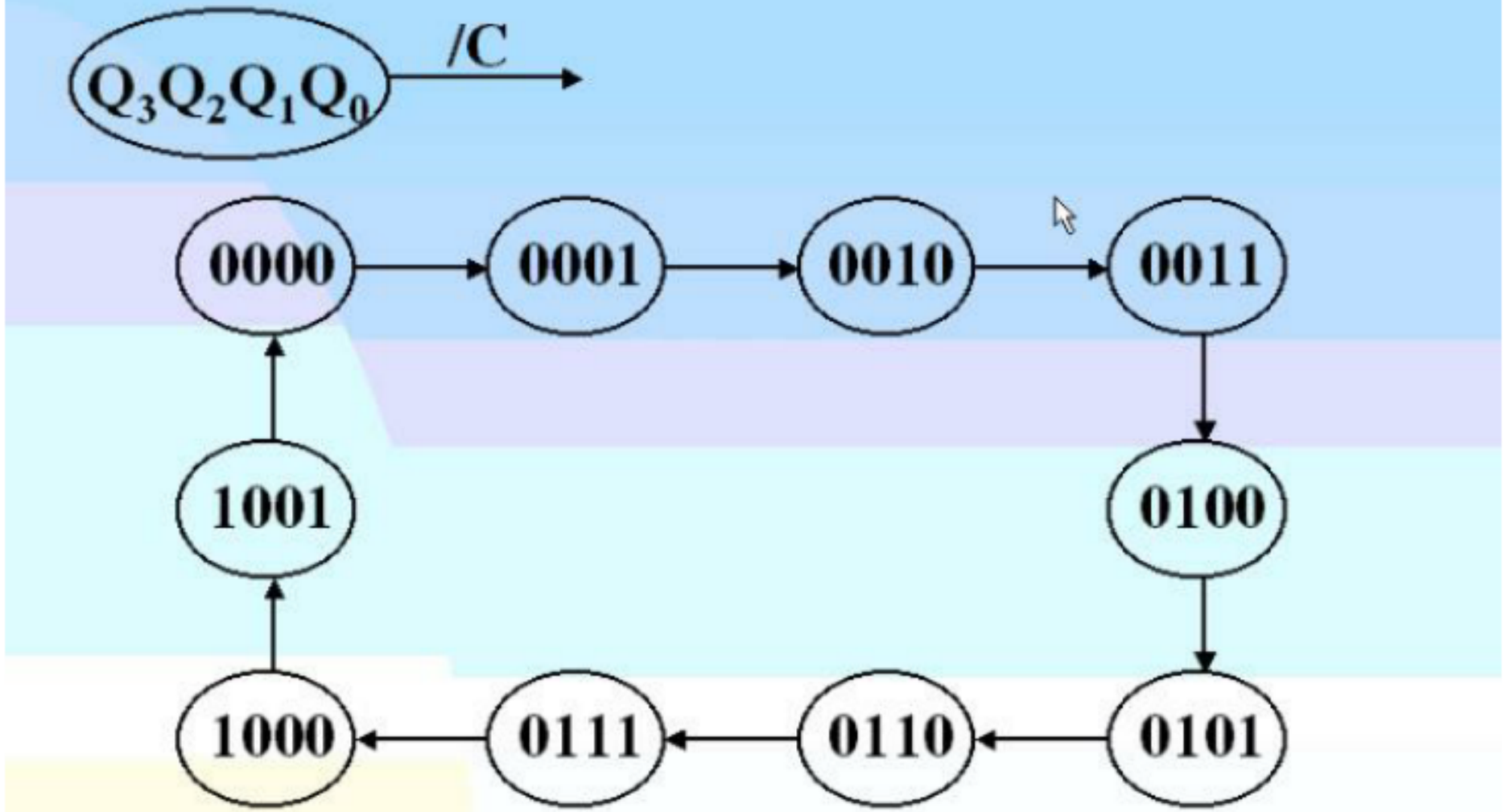
$$Q_3^{n+1} = Q_1\ Q_2\ \overline{Q}_3^{n} \bullet CP_1$$

$$\begin{cases} J_0 = K_0 = 1 \\ J_1 = \overline{Q}_3, \quad K_1 = 1 \\ J_2 = K_2 = 1 \\ J_3 = Q_1 Q_2, \quad K_3 = 1 \end{cases}$$

5）状态转换表

Q_3^n	Q_2^n	Q_1^n	Q_0^n	$CP_1 = Q_0$	$CP_2 = Q_1$	Q_3^{n+1}	Q_2^{n+1}	Q_1^{n+1}	Q_0^{n+1}
0	0	0	0	0 ✗→ 1	0 ✗→ 0	0	0	0	1
0	0	0	1	1 ✓→ 0	0 ✗→ 1	0	0	1	0
0	0	1	0	0 ✗→ 1	1 ✗→ 1	0	0	1	1
0	0	1	1	1 ✓→ 0	1 ✓→ 0	0	1	0	0
0	1	0	0	0 ✗→ 1	0 ✗→ 0	0	1	0	1
0	1	0	1	1 ✓→ 0	0 ✗→ 1	0	1	1	0
0	1	1	0	0 ✗→ 1	1 ✗→ 1	0	1	1	1
0	1	1	1	1 ✓→ 0	1 ✓→ 0	1	0	0	0
1	0	0	0	0 ✗→ 1	0 ✗→ 0	1	0	0	1
1	0	0	1	1 ✓→ 0	0 ✗→ 0	0	0	0	0

6）状态图



功能：异步十进制加计数器