

习题

习题1.10

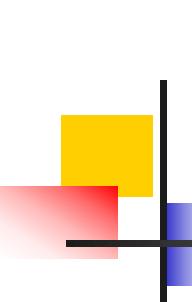


习题

1. 10 将下列8421BCD码转换成十进制数和二进制数

- (1) 011010000011
- (2) 01000101. 1001

解: (1) $(011010000011)_{8421BCD} = (683)_D = (1010101011)_2$
(2) $(01000101. 1001)_{8421BCD} = (45. 9)_D = (101101. 1110)_2$



习题

习题1.11

习题

1.11 试用8421BCD码、余3码和格雷码分别表示下列各数

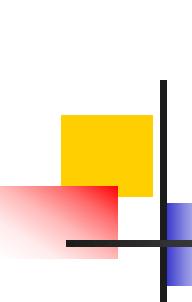
$$(1) (578)_{10}$$

$$(2) (1100110)_2$$

解：(1) $(578)_{10} = (010101111000)_{8421BCD} = (100010101011)_{\text{余3码}}$
 $= (1001000010)_2 = (1101100011)_{\text{格雷码}}$

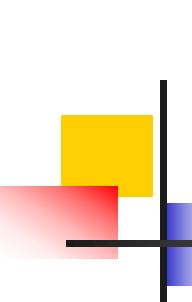
$$(2) (1100110)_2 = (1010101)_{\text{格雷码}} = (102)_{10}$$

$$= (000100000010)_{8421BCD} = (010000110101)_{\text{余3码}}$$



习题

习题1.12



习题

1. 12 将下列一组数按从小到大顺序排序

$$(11011001)_2, (135.6)_8, (27)_{10}, (3AF)_{16}, (00111000)_{8421BCD}$$

$$(11011001)_2 = (217)_{10}$$

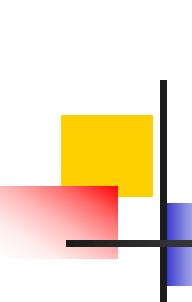
$$(135.6)_8 = (93.75)_{10}$$

$$(3AF)_{16} = (943)_{10}$$

$$(00111000)_{8421BCD} = (38)_{10}$$

∴按从小到大顺序排序为：

$$(27)_{10}, (00111000)_{8421BCD}, (135.6)_8, (11011001)_2, (3AF)_{16}$$



习题

习题2.4

习题

2.4 求下列函数的反函数和对偶函数

$$(1) F = \overline{A}\overline{C} + \overline{B}C$$

$$\overline{F} = (\overline{A} + C)(B + \overline{C})$$

$$F' = (A + \overline{C})(\overline{B} + C)$$

$$(2) F = \overline{A}B + B\overline{C} + A(C + \overline{D})$$

$$\overline{F} = (A + \overline{B})(\overline{B} + C)(\overline{A} + \overline{C}D)$$

$$F' = (\overline{A} + B)(B + \overline{C})(A + C\overline{D})$$

$$(3) F = A[\overline{B} + (C\overline{D} + \overline{E}F)G]$$

$$\overline{F} = \overline{A} + B[(\overline{C} + D)(E + \overline{F}) + \overline{G}]$$

$$F' = A + \overline{B}[(C + \overline{D})(\overline{E} + F) + G]$$

习题

2.4 求下列函数的反函数和对偶函数

$$(4) F = A + \overline{B} + \overline{\overline{C}} + \overline{\overline{D}} + \overline{\overline{\overline{E}}}$$

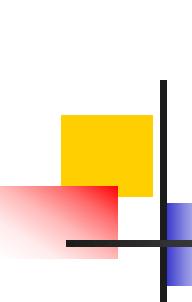
$$\overline{F} = \overline{A} \cdot \overline{\overline{B}} \cdot C \cdot \overline{\overline{D}} \cdot E$$

$$F' = A \cdot B \cdot \overline{C} \cdot \overline{\overline{D}} \cdot \overline{\overline{E}}$$

$$(5) F = (\overline{A} + B)(B + \overline{AC})$$

$$\overline{F} = \overline{AB} + \overline{B} \cdot (A + \overline{C}) = (\overline{A} + B)(B + \overline{AC})$$

$$F' = \overline{AB} + B \cdot (\overline{A} + C)$$



习题

思考习题2.7

习题 2.7 参考解答

2.7 将下列函数表示成“最小项之和”形式和“最大项之积”形式：

$$(1) F(A,B,C) = \overline{AB} + \overline{AC} = \Sigma m(0,4,5,6,7) = \Pi M(1,2,3)$$

$$(2) F(A,B,C,D) = \overline{AB} + A\overline{B}\overline{C}D + BC + B\overline{C} \cdot \overline{D} = \Sigma m(4,5,6,7,12,13,14,15)$$

$$= \Pi M(0,1,2,3,8,9,10,11)$$

$$(3) F(A,B,C,D) = (\overline{A} + BC)(\overline{B} + \overline{C} \cdot \overline{D}) = \Sigma m(0,1,2,3,4)$$

$$= \Pi M(5,6,7,8,9,10,11,12,13,14,15)$$

		A	B		
		00	01	11	10
C	0	1	0	1	1
	1	0	0	1	1

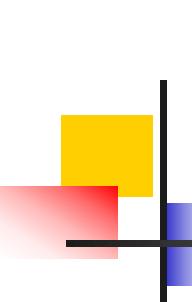
(1)

		A	B		
		00	01	11	10
CD	00	0	1	1	0
	01	0	1	1	0
	11	0	1	1	0
	10	0	1	1	0

(2)

		A	B		
		00	01	11	10
CD	00	1	1	0	0
	01	1	0	0	0
	11	1	0	0	0
	10	1	0	0	0

(3)



习题

思考习题2.13

习题 2.13 参考解答

2.13 用卡诺图化简包含无关取小项的函数和多输出函数：

$$(1) F(A,B,C,D) = \sum m(0,2,7,13,15) + \sum d(1,3,4,5,6,8,10) \\ = \overline{A} + BD$$

$$(2) \begin{cases} F_1(A,B,C,D) = \sum m(0,2,4,7,8,10,13,15) = \overline{BD} + ABD + \overline{ABC}\overline{D} + \overline{ABCD} \\ F_2(A,B,C,D) = \sum m(0,1,2,5,6,7,8,10) = \overline{BD} + \overline{ACD} + \overline{AC}\overline{D} + \overline{ABCD} \\ F_3(A,B,C,D) = \sum m(2,3,4,7) = \overline{ABC} + \overline{ABC}\overline{D} + \overline{ABCD} \end{cases}$$

	AB	00	01	11	10
CD	00	1	d		d
00	01	d	d	1	
11	11	d	1	1	
10	10	1	d		d

	AB	00	01	11	10
CD	00	1	1		1
00	01			1	
11	11	1	1		
10	10	1			1

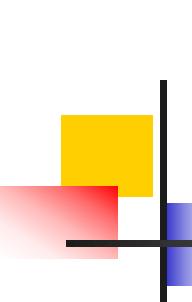
$F_1(A, B, C, D)$

	AB	00	01	11	10
CD	00	1			1
00	01	1	1		
11	11	1			
10	10	1	1		1

$F_2(A, B, C, D)$

	AB	00	01	11	10
CD	00		1		
00	01				
11	11	1	1		
10	10	1			

$F_3(A, B, C, D)$



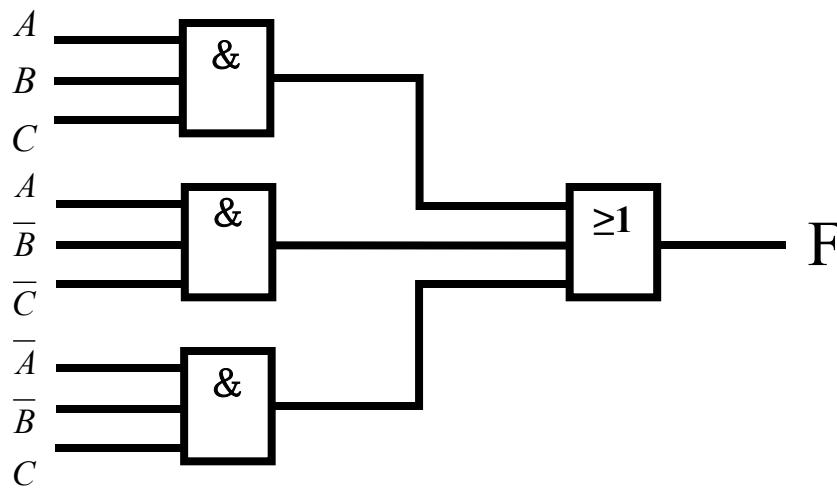
习题

思考习题3.4

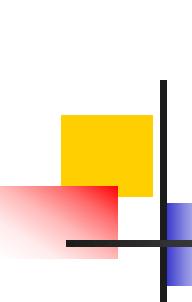
习题 3.4 参考解答

3.4 分析下图3.48所示逻辑电路图,并求出简化逻辑电路:

$$\begin{aligned}F &= (A + \overline{(B + \bar{C})(\bar{B} + C)}) \cdot (\bar{A}C + (B + \bar{C})(\bar{B} + C)) \\&= (A + \bar{B}C + B\bar{C}) \cdot (\bar{A}C + BC + \bar{B}\bar{C}) \\&= ABC + A\bar{B}\bar{C} + \bar{A}\bar{B}C\end{aligned}$$



注: F 的表达式也可转化成包含同或符号的形式, 此时逻辑电路图也需使用相应的同或门。



习题

思考习题4.6

习题 4.6 参考解答

该电路的激励函数和输出函数表达式如下：

$$J_1 = Q_1 \overline{Q_2} \quad K_1 = xQ_2 + Q_1 \overline{Q_2} \quad J_2 = \overline{x}Q_2 \quad K_2 = Q_2 \quad Z_1 = Q_1 \quad Z_2 = Q_2$$

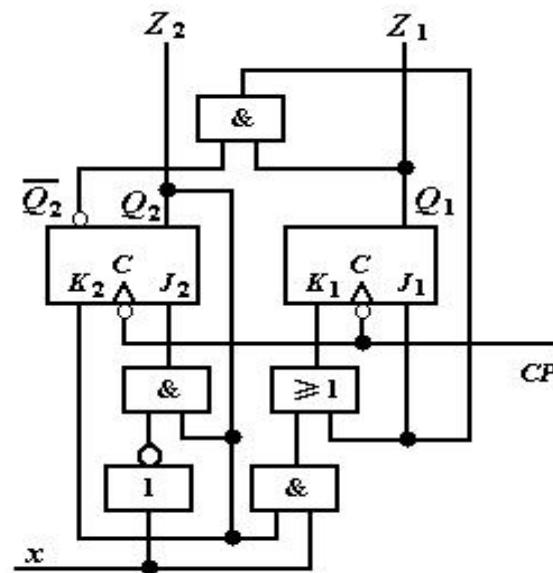
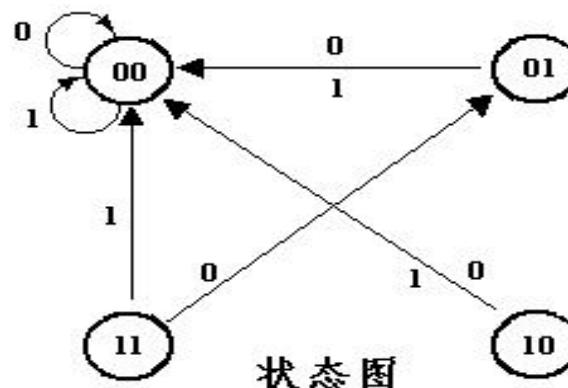


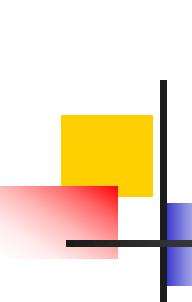
图 4.58 某同步时序电路



该电路的逻辑功能为在时钟脉冲作用下，
输入任意序列 x 均使电路返回 00 状态。

现态 Q_2Q_1	次态 $Q_2^{n+1}Q_1^{n+1}$	
	$x=0$	$x=1$
00	00	00
01	00	00
10	00	00
11	01	00

状态表



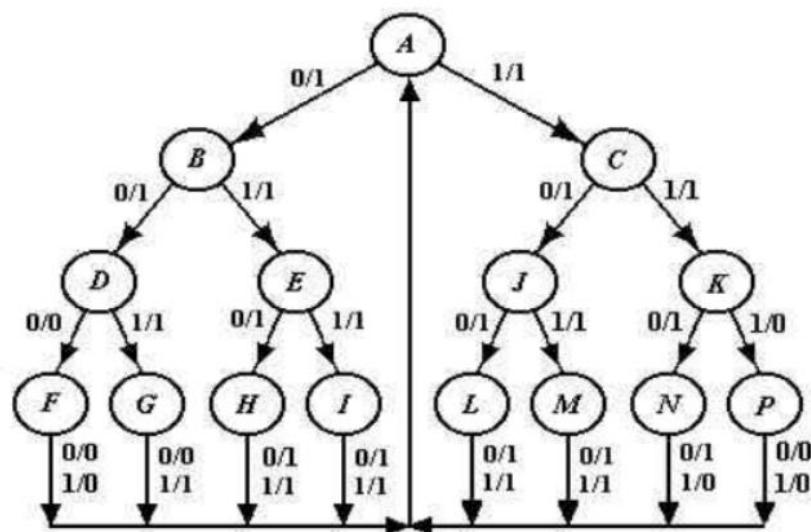
习题

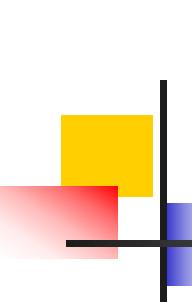
思考习题4.9

习题 4.9 参考解答

4.9 设计一个代码检测器，电路串行输入余3码，当输入出现非法数字时电路输出为0，否则输出为1，试作出状态图。

解：余3码的非法数字有六个，即0000，0001，0010，1101，1110，1111。故其原始状态图为：





习题

思考习题4.12

习题 4.12 参考解答

作隐含表如下图所示，确定如下相容状态对：

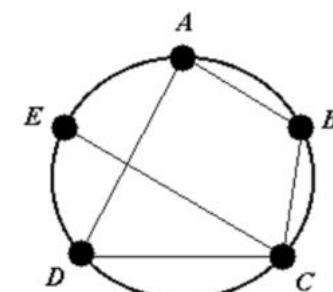
(A, B) , (A, D) , (B, C) , (C, D) , (C, E)

通过隐含表画出合并图可以看出 5 个相容状态对本身就是最大相容类

现态	次态/输出	
	$x=0$	$x=1$
A	D/d	C/0
B	D/1	E/d
C	d/d	E/1
D	A/0	C/d
E	B/1	C/d

B	CE		
C	✗	∨	
D	∨	✗	CE
E	BD	BD ✗ CE	∨

A B C D



习题 4.12 参考解答

作出如下左图闭覆盖表寻找出右图最小闭覆盖：

最大相容类	闭 覆 盖					闭 合	
	A	B	C	D	E	$x=0$	$x=1$
AB	∨	∨				D	CE
AD	∨			∨		AD	C
BC		∨	∨			D	E
CD			∨	∨		A	CE
CE			∨		∨	B	CE

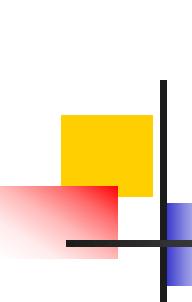


最大相容类	闭 覆 盖					闭 合	
	A	B	C	D	E	$x=0$	$x=1$
AB	∨	∨				D	CE
CD			∨	∨		A	CE
CE			∨		∨	B	CE

用状态 A 代表状态 AB，用状态 B 代表状态 CD，用状态 C 代表状态 CE，则可得如下最小化状态表：

最 小 化 状 态 表

现态	次态/输出	
	$x=0$	$x=1$
A	B/1	C/0
B	A/0	C/1
C	A/1	C/1



习题

思考习题4.14

习题 4.14 参考解答

根据给定的二进制状态表和 J-K 触发器、T 触发器以及 D 触发器各自的激励表，可画出下述激励函数和输出函数的卡诺图：

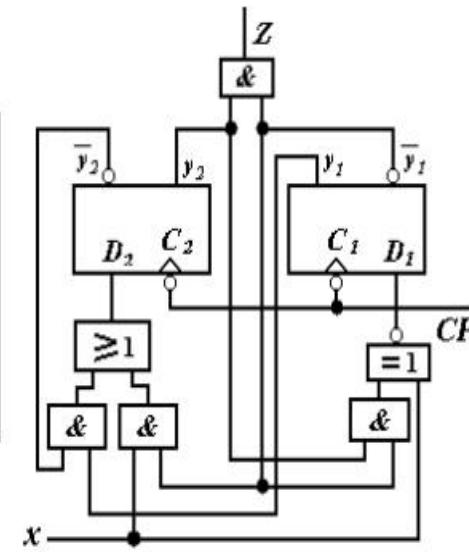
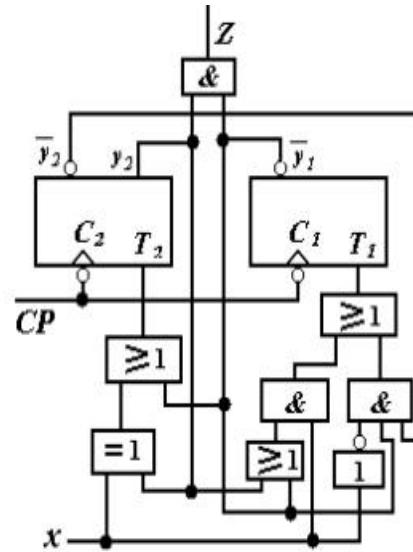
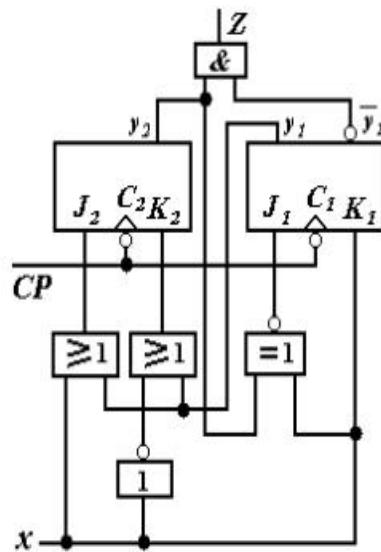
$x \backslash y_2 y_1$	00	01	01	01	01	01	01	01	01	01	01
00	0 1	d d	1 0	d	0 1	1 0	0 1	0 1	1 0	0 0	0 0
01	1 1	d d	d d	0 1	1 1	0 1	1 1	1 1	0 0	0 0	0 0
11	d d	1 1	1 1	d	d	0 1	1 1	0 1	0 0	1 0	0 0
10	d d	1 0	0 0	1	d	d	1 0	0 0	1 0	1 0	1 1
	J_2	K_2	J_1	K_1	T_2	T_1	D_2	D_1		Z	

通过化简卡诺图可得各触发器的激励函数和输出函数的表达式如下：

$$\begin{aligned}
 J_2 &= y_1 + x & K_2 &= y_1 + \bar{x} & J_1 &= \bar{x} \cdot \bar{y}_2 + xy_2 = \bar{x} \oplus y_2 & K_1 &= x \\
 T_2 &= y_1 + xy_2 + \bar{x}y_2 = y_1 + x \oplus y_2 & T_1 &= \bar{x}y_2y_1 + xy_1 + xy_2 = \bar{x}y_2y_1 + x(y_1 + y_2) \\
 D_2 &= \bar{y}_2y_1 + xy_1 & D_1 &= \bar{x} \cdot \bar{y}_2 + \bar{x}y_1 + xy_2\bar{y}_1 = \bar{x} \oplus (\bar{y}_2\bar{y}_1) \\
 Z &= y_2\bar{y}_1
 \end{aligned}$$

习题 4.14 参考解答

根据激励函数和输出函数的表达式可画出各逻辑电路如下：

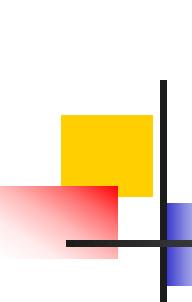


用 J-K 触发器的同步时序电路

用 T 触发器的同步时序电路

用 D 触发器的同步时序电路

由此可见，使用 J-K 触发器线路较为简单，门电路较少，成本较低。

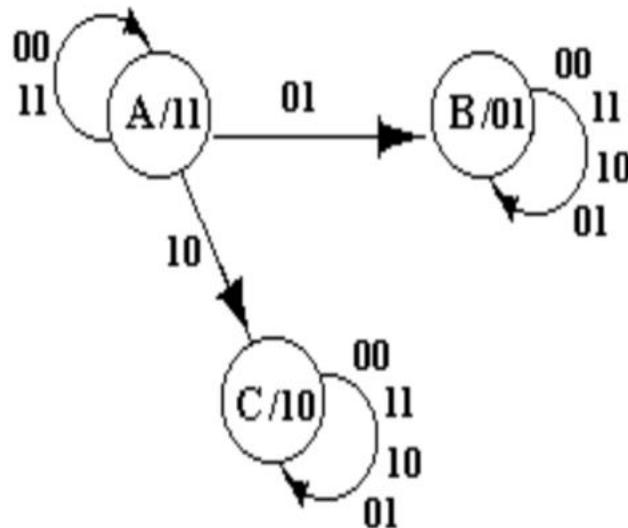


习题

思考习题4.15

习题 4.15 参考解答

因题意要求用尽可能少的状态数作出状态图和状态表，并用尽可能少的逻辑门和触发器来实现，故采用 Moore 型电路，采用两个 D 触发器。两个 D 触发器的输出就是电路的输出，其中 y_2 表示 Z_y , y_1 表示 Z_x 。用 A、B、C 三个状态分别表示 $X = Y$ 、 $X < Y$ 、 $X > Y$ 。由此可做出下述状态图和状态表：



现态	次态			
	$x_i y_i = 00$	$x_i y_i = 01$	$x_i y_i = 11$	$x_i y_i = 10$
A	A	B	A	C
B	B	B	B	B
C	C	C	C	C

习题 4.15 参考解答

令 $A = 11$, $B = 01$, $C = 10$, 可得如下二进制状态表:

$y_2 y_1$	$y_2^{n+1} y_1^{n+1}$			
	$x_i y_i = 00$	$x_i y_i = 01$	$x_i y_i = 11$	$x_i y_i = 10$
01	01	01	01	01
11	11	01	11	10
10	10	10	10	10

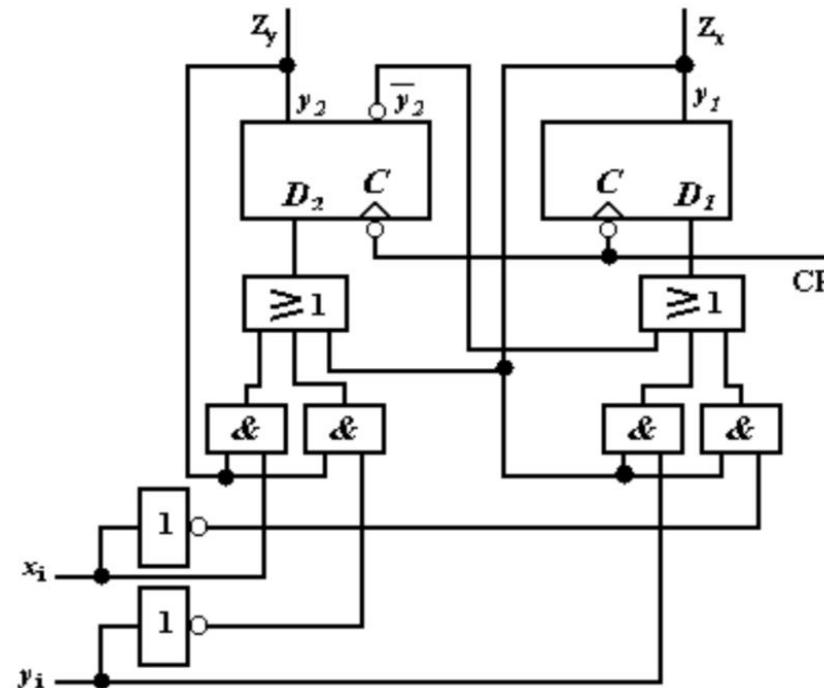
根据给定的二进制状态表和 D 触发器的激励表, 可画出下述激励函数和输出函数的卡诺图, 进一步化简可得激励函数和输出函数的表达式:

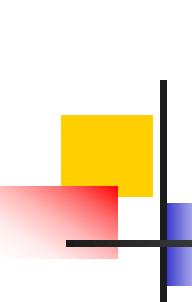
$x_i y_i$	D ₂				D ₁			
	00	01	11	10	00	01	11	10
00	d	d	d	d	d	d	d	d
01	0	0	0	0	1	1	1	1
11	1	0	1	1	1	1	1	0
10	1	1	1	1	0	0	0	0

习题 4.15 参考解答

$$D_2 = y_1 + x_i y_2 + \overline{y_i} y_2 \quad D_1 = \overline{y_2} + y_i y_1 + \overline{x_i} y_1 \quad Z_y = y_2 \quad Z_x = y_1$$

所设计的同步时序逻辑电路如下：





习题

思考习题5.1

习题 5.1 参考解答

5.1 分析图5.35所示的脉冲异步时序电路

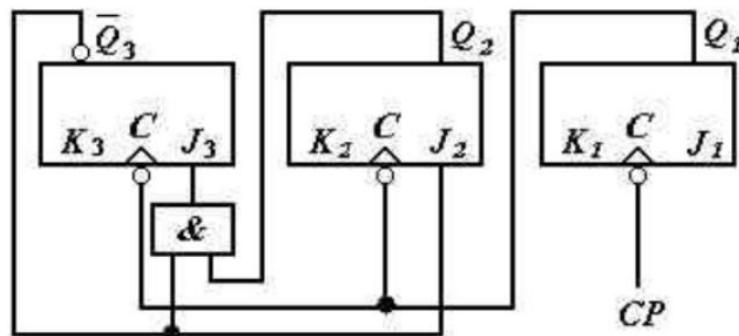


图5-35 脉冲异步时序电路

解：各触发器的激励方程和时钟方程为：

$$J_1 = K_1 = 1, J_2 = \overline{Q_3}, K_2 = 1, J_3 = Q_2 \overline{Q_3}, K_3 = 1$$

$$CP_1 = CP, CP_2 = CP_3 = Q_1$$

习题 5.1 参考解答

各触发器的状态方程为：

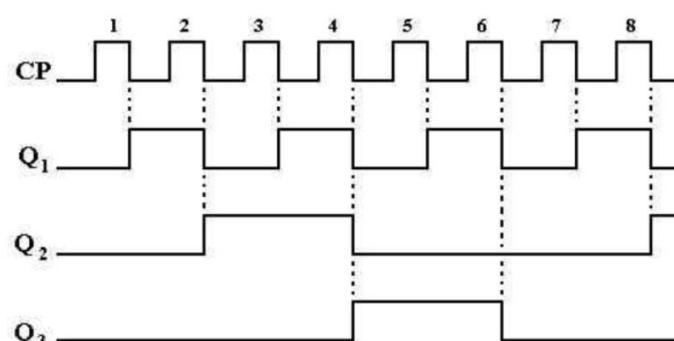
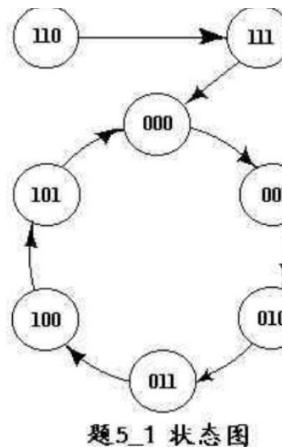
$$Q_1^{n+1} = \overline{Q}_1 \quad (CP\text{的下降沿触发})$$

$$Q_2^{n+1} = \overline{Q}_2 Q_3 \quad (Q_1\text{的下降沿触发})$$

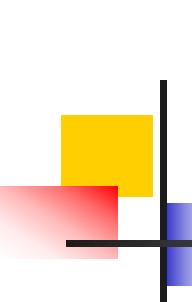
$$Q_3^{n+1} = Q_2 \overline{Q}_3 \quad (Q_1\text{的下降沿触发})$$

题5_1 状态真值表

现态 $Q_3Q_2Q_1$	激励函数								次态 $Q_3Q_2Q_1$
	CP_3	J_3	K_3	CP_2	J_2	K_2	CP_1	J_1	
000	0	0	1	0	1	1	1	1	001
001	1	0	1	1	1	1	1	1	010
010	0	1	1	0	1	1	1	1	011
011	1	1	1	1	1	1	1	1	100
100	0	0	1	0	0	1	1	1	101
101	1	0	1	1	0	1	1	1	000
110	0	0	1	0	0	1	1	1	111
111	1	0	1	1	0	1	1	1	000



该电路是一个能自启动的六进制计数器



习题

思考习题6.7

习题 6.7 参考解答

6.7 ROM 实现的组合逻辑电路如图 6.43 所示, 试分析该电路功能, 分别说明 XYZ 为何种取值时, 逻辑函数 $F_1 = F_2 = 1$ 和 $F_1 = F_2 = 0$ 。

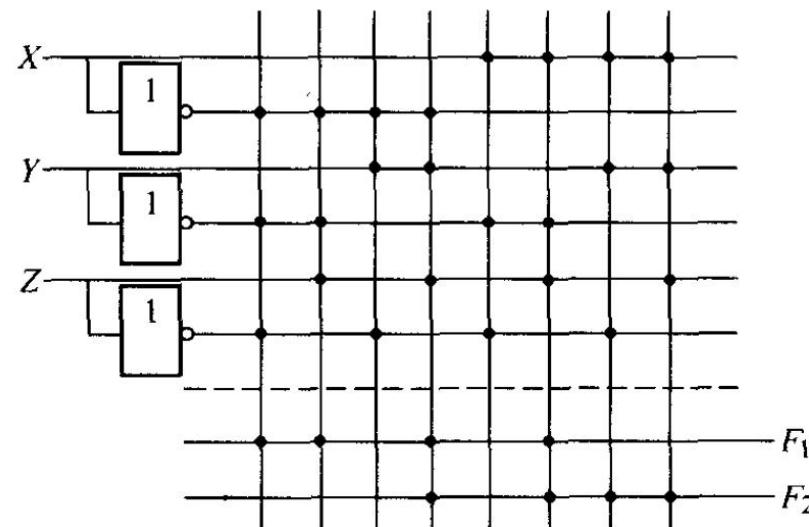


图 6.43 给定 ROM 阵列逻辑图

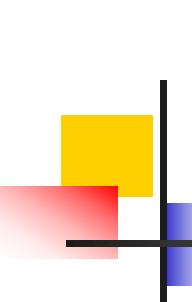
习题 6.7 参考解答

X	Y	Z	F ₁	F ₂
0	0	0	1	0
0	0	1	1	0
0	1	0	0	0
0	1	1	1	1
1	0	0	0	0
1	0	1	1	1
1	1	0	0	1
1	1	1	0	1

$$F_1 = \overline{XYZ} + \overline{X}\overline{Y}Z + \overline{X}YZ + X\overline{Y}Z$$

$$F_2 = \overline{XYZ} + X\overline{Y}Z + XY\overline{Z} + XYZ$$

- (1) 当 $XYZ = 011, 101$ 时, $F_1 = F_2 = 1$
(2) 当 $XYZ = 010, 100$ 时, $F_1 = F_2 = 0$



习题

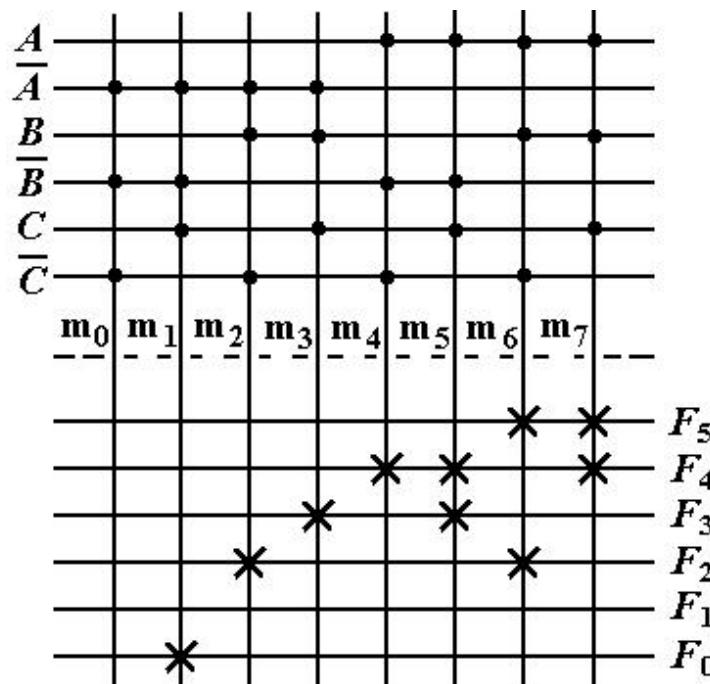
思考习题6.8

习题 6.8 参考解答

6.8 用 ROM 设计一个 3 位二进制平方器。

三位二进制平方器真值表

输入 ABC	输出					
	F_5	F_4	F_3	F_2	F_1	F_0
000	0	0	0	0	0	0
001	0	0	0	0	0	1
010	0	0	0	1	0	0
011	0	0	1	0	0	1
100	0	1	0	0	0	0
101	0	1	1	0	0	1
110	1	0	0	1	0	0
111	1	1	0	0	0	1



题6_7 平方器的阵列逻辑图