

数字电路与数字系统

第四章作业

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6(a).

6(a)

$$F = W \cdot X \cdot Y \cdot Z \cdot (W \cdot X \cdot Y \cdot Z' + W \cdot X' \cdot Y \cdot Z + W \cdot X \cdot Y \cdot Z + W \cdot X \cdot Y' \cdot Z)$$

$$= W \cdot X \cdot Y \cdot Z \cdot Z' + W \cdot X \cdot X' \cdot Y \cdot Z + W \cdot W \cdot X \cdot Y \cdot Z + W \cdot X \cdot Y \cdot Y' \cdot Z$$

$$= 0$$

7(b).

7(b)

$$F = W' \cdot X + Y' \cdot Z' + X' \cdot Z$$

W	X	Y	Z	F
0	0	0	0	1
0	0	0	1	1
0	0	1	0	0
0	1	0	0	1
1	0	0	0	1
0	0	1	1	1
0	1	0	1	1
1	0	0	1	1
0	1	1	0	1
1	0	1	0	0
1	1	0	0	1
0	1	1	1	1
1	1	0	1	0
1	0	1	1	1
1	1	1	0	0
1	1	1	1	0

7(f).

7(f)
 $F = (A + B' \cdot C \cdot D) \cdot (B' + C' + D \cdot E')$
 ~~$A \cdot B' + B' \cdot C \cdot D + A'$~~

A	B	C	D	E	F	A	B	C	D	E	F
0	0	0	0	0	0	1	1	0	0	1	0
0	0	0	0	1	1	0	1	1	1	0	1
0	0	0	1	0	1	1	1	0	1	0	0
0	0	1	0	0	1	1	1	1	0	0	0
0	1	0	0	0	1	0	1	1	1	1	0
1	0	0	0	0	0	1	0	1	1	1	1
0	0	0	1	1	1	1	1	0	1	1	0
0	0	1	0	1	1	1	1	1	0	1	0
0	1	0	0	1	1	1	1	1	1	0	0
1	0	0	0	1	0	1	1	1	1	1	0
0	1	0	1	0	1						
0	1	0	1	0	1						
1	0	0	1	0	0						
0	1	1	0	0	0						
1	0	1	0	0	0						
1	1	0	0	0	0						
0	0	1	1	1	1						
0	1	0	1	1	1						
1	0	0	1	1	0						
0	1	1	0	1	0						
1	0	1	0	1	0						

10(c).

10(c)
 $F = \sum_{A,B,C,D} (1, 2, 5, 6) \leftarrow$ 标准值积.
 标准值积:
 $F = \prod_{A,B,C,D} (0, 3, 4, 7, 8, 9, 10, 11, 12, 13, 14, 15)$

10(f).

10(f)
 $F = A' \cdot B + B' \cdot C + A$

	A	B	C	F
m0	0	0	0	0
m1	0	0	1	1
m2	0	1	0	1
m3	0	1	1	1
m4	1	0	0	1
m5	1	0	1	1
m6	1	1	0	1
m7	1	1	1	1

标准值积:
 $F = \sum_{A,B,C,D} (1, 2, 3, 4, 5, 6, 7)$
 标准值积:
 $F = \prod_{A,B,C,D} (0)$

15(d).

15(d)
 $F = \sum_{w,x,y,z} (0, 1, 2, 3, 7, 8, 10, 11, 15)$

wx \ yz	00	01	10	11
00	1	1	1	1
01				1
10	1			
11				

wx \ yz	00	01	11	10
00	1	1	1	1
01			1	
11			1	
10	1		1	1

红笔圈的即为奇异 1，积之和为 $F = W' X' + YZ + X' Z'$

15(e).

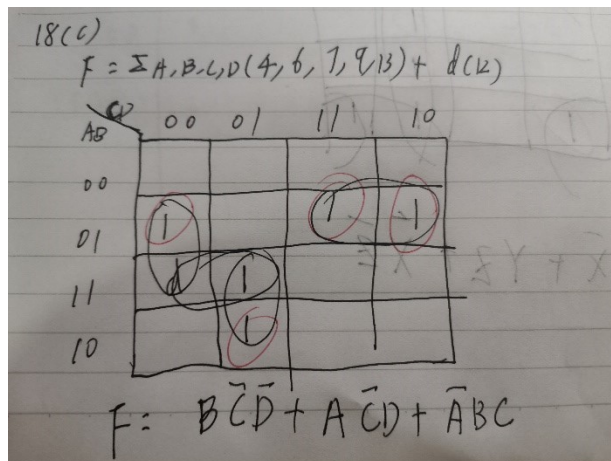
15(e)
 $F = \sum_{w,x,y,z} (1, 2, 4, 7, 8, 11, 13, 14)$

wx \ yz	00	01	11	10
00		1		1
01	1		1	
11		1		1
10	1		1	

全是奇数 1

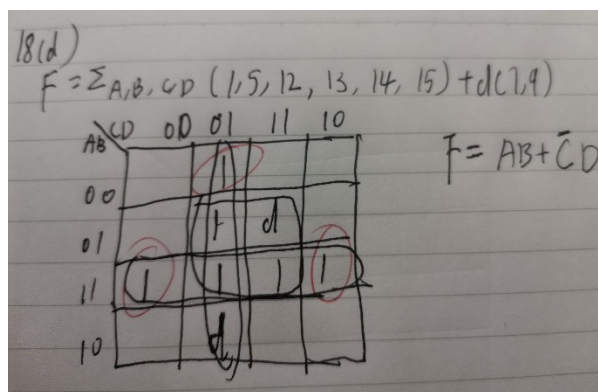
$$F = \bar{w}\bar{x}\bar{y}z + \bar{w}\bar{x}y\bar{z} + \bar{w}x\bar{y}z + \bar{w}xy\bar{z} + w\bar{x}\bar{y}z + w\bar{x}y\bar{z} + wx\bar{y}z + wxy\bar{z}$$

18(c).



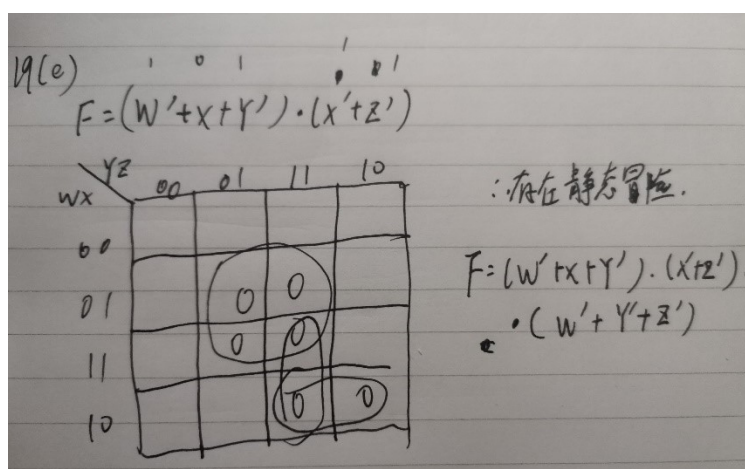
红笔圈的即为奇异 1

18(d).



红笔圈的即为奇异 1

19(e).



19(f).

19(f) $F = (W + Y' + Z') \cdot (W' + X' + Z') \cdot (X' + Y + Z)$

	00	01	11	10
00			0	
01	0		0	
11	0	0	0	
10			0	

存在静态冒险

$F = (W + Y' + Z') \cdot (W' + X' + Z')$
 $\cdot (X' + Y + Z) \cdot (W' + X' + Y)$
 $\cdot (X' + Y' + Z')$

19(g).

19(g) $F = (W + Y + Z') \cdot (W' + X' + Y + Z) \cdot (X' + Y') \cdot (X + Z)$

	00	01	11	10
00	0	0		0
01	0	0	0	0
11			0	0
10	0			0

存在静态冒险

$F = (X' + Y') \cdot (Y' + Z)$
 $\cdot (W + Y) \cdot (X + Z)$
 $\cdot (W + X')$

24.

24. $(X + Y) \cdot (X' + Z) = X \cdot Z + X' \cdot Y$

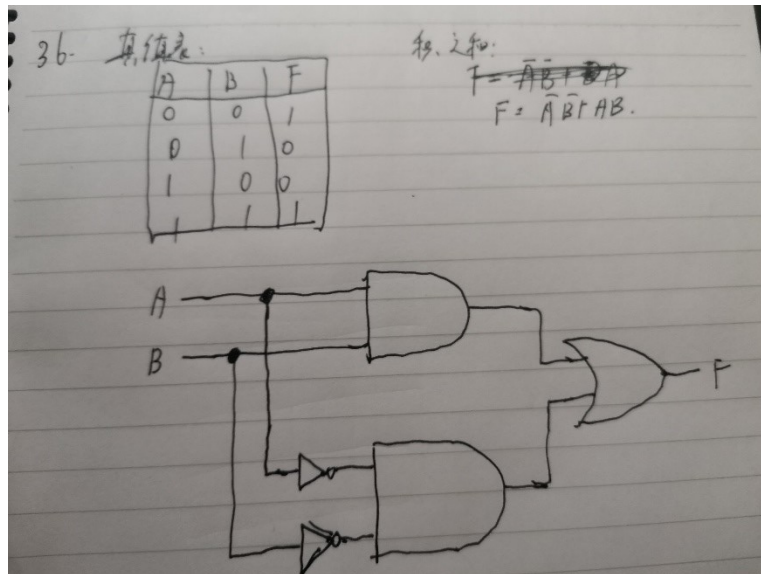
原式 $= X \cdot (X' + Z) + Y \cdot (X' + Z)$

$= \cancel{X \cdot X'} + X \cdot Z + X' \cdot Y + \cancel{Y \cdot Z}$

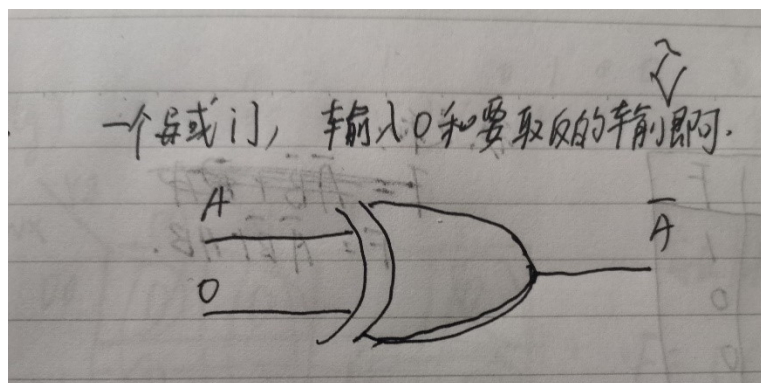
$= X \cdot Z + X' \cdot Y + Y \cdot Z$

由T11
 $X \cdot Z + X' \cdot Y$

36.



38.



45. (??? 不会)

有 XY、XZ、YZ、XYZ 四种输入，所以有 $2^4=16$ 种逻辑函数

46.

46. 证明: $(X+Y) \cdot (X+Z) = X+Y \cdot Z$

证: $X + X \cdot Z + X \cdot Y + Y \cdot Z$

$= X \cdot (1+Y+Z) + Y \cdot Z$

$= X + Y \cdot Z$

55.

55. B_2, B_1, B_0

P_2, P_1, P_0	000	001	011	010	110	111	101	100
000	0	0	1	1	1	1	1	1
001	0	0	1	1	1	1	1	1
011	0	1	1	1	1	1	1	1
010	0	1	1	1	1	1	1	1
110	1	1	1	1	1	1	1	1
111	1	1	1	1	1	1	1	1
101	1	1	1	1	1	1	1	1
100	1	1	1	1	1	1	1	1

$F = P_2 P_1' Q_2 + P_2 Q_1 P_1' + P_2 P_1' Q_1$
 $+ P_2 P_1' P_0' Q_2' Q_1 + P_1 P_0 Q_2 Q_1 Q_0 + P_2 P_1' P_0 Q_2 Q_1$
 $+ P_2' P_1 P_0' Q_2' Q_1 Q_0$

56.

56. $F = \sum_{x,y,z} (0, 1, 2)$

$x \backslash yz$	00	01	11	10
0	0	1	1	0
1	1	1	1	1

$F = \bar{x}\bar{y} + \bar{x}\bar{z}$

$G = \sum_{x,y,z} (1, 4, 6)$

$x \backslash yz$	00	01	11	10
0	0	1	1	0
1	1	1	1	1

$G = x\bar{z} + \bar{x}\bar{y}z$

$H = \sum_{x,y,z} (0, 1, 2, 4, 6)$

$x \backslash yz$	00	01	11	10
0	1	1	1	1
1	1	1	1	1

$H = \bar{z} + \bar{x}\bar{y}$

61.

61.

$2B \rightarrow \neg \neg \neg \rightarrow F$

$F = 2B + (2B)'$

$2B$ ———— \neg ———— \neg ———— \neg ———— F

$2B$ ———— F

用 QM 方法化简 59(c) 和 60(a):

59(c)

59(c) $F = \sum w, x, y, z (0, 1, 2, 3, 4, 5, 10, 11, 14, 20, 21, 24, 25, 26, 27, 28, 29, 30)$

最小项	VWXYZ	解
0	00000	
1	00001	✓
2	00010	✓
4	00100	✓
3	00011	✓
5	00101	✓
10	01010	✓
20	10100	✓
24	11000	✓
11	10011	✓
14	10110	✓
21	10101	✓
25	11001	✓
26	11010	✓
28	11100	✓
27	11011	✓
29	11101	✓
30	11110	✓

最小项	VWXYZ	解
0, 1	0000-	
0, 2	000-0	✓
0, 4	00-00	✓
2, 3	0001-	✓
2, 10	0-010	P1
1, 3	000-1	✓
1, 5	00-01	✓
4, 5	0010-	P2
4, 20	-0100	✓
3, 11	-0011	P3
5, 21	-0101	✓
10, 26	-1010	P4
20, 14	1010-	✓
20, 21	1010-	P45
20, 28	-1-100	✓
24, 25	1100-	✓
24, 28	11-00	✓
24, 26	110-0	✓
11, 27	1-011	P5, P6
21, 29	1-101	✓
25, 29	11-01	✓
26, 27	1101-	✓
28, 30	111-0	✓
再次检查	0, 1, 2, 3	000--
0	0, 2, 1, 3	000--
0, 4, 1, 5	00-0-	P6, P7

4, 20, 5, 21 -010- P8

20, 14, 28, 30 1-1-0 P9, 10

20, 28, 21, 29 1-10- P10, 11

24, 15, 26, 27 110- P12

24, 28, 25, 29 11-0- P13

24, 26, 28, 30 11-0- P14

2, 10, 14, 5, 11, 14, 10, 26, 21, 29, 25, 27, 28, 30

14, 28, 29, 26, 25, 20

原函数:

	0	1	2	3	4	5	10	11	14	20	21	24	25	26	27	28	29	30
P1 (2, 10)																		
P2 (4, 5)																		
P3 (3, 11)																		
P4 (10, 26)																		
P5 (20, 21)																		
P6 (11, 27)																		
P7 (0, 1, 2, 3)																		
P8 (0, 1, 4, 5)																		
P9 (2, 10, 24, 25, 26, 27)																		
P10 (20, 21, 28, 29)																		
P11 (20, 21)																		
P12 (4, 5, 20, 21)																		
P13 (24, 28, 25, 29)																		
P14 (24, 26, 28, 30)																		

原函数含项 P10, 包含项 m14, m20, m26, m30.

	0	1	2	3	4	5	10	11	21	24	25	26	27	29
P1 (2, 10)														
P2 (4, 5)														
P3 (3, 11)														
P4 (10, 26)														
P5 (11, 27)														
P6 (0, 1, 2, 3)														
P7 (0, 1, 4, 5)														
P8 (2, 10, 24, 25, 26, 27)														
P9 (20, 21)														
P10 (4, 5, 20, 21)														
P11 (20, 28, 25, 29)														

P11, P7, P12, P8, P1, P3.

$$F(V, W, X, Y, Z) = 1-10- + 000-- + 110-- + 00-0- + 0-010 + 00011$$

$$= \bar{V}\bar{W}\bar{X}\bar{Y} + \bar{V}\bar{W}\bar{X} + \bar{V}\bar{W}X + \bar{V}\bar{W}Y$$

$$+ \bar{V}\bar{X}Y\bar{Z} + \bar{W}\bar{X}YZ$$

60(a)

b0(a) $F = \sum uvwx12 (1, 5, 9, 13, 21, 23, 29, 31, 37, 45, 53, 61)$

组别	最小项	UVWxyz	
1	1	000001	✓
2	5	000101	✓
	9	001001	✓
3	13	001101	✓
	21	010101	✓
	23	100101	✓
4	29	001101	✓
	45	101101	✓
	53	110101	✓
5	31	011111	✓
	61	111101	✓
1	1, 5	000-01	✓
	1, 9	00-001	✓
	5, 13	00-101	✓
2	5, 21	0-0101	✓
	5, 37	-00101	✓
	9, 13	001-01	✓
3	13, 29	0-01101	✓
	13, 45	-01101	✓
	21, 29	01-101	✓
	21, 53	-10101	✓
	21, 23	0101-1	P1
	37, 45	10-101	✓
	23, 29	1-0101	✓

4	23, 31	01-111	✓
	29, 61	-11101	✓
	45, 61	1-1101	✓
	53, 61	11-101	✓
每次:	1, 5, 9, 13	00--01	P2
	1, 9, 5, 13	00--01	
2	5, 13, 21, 29	0--101	✓
	5, 13, 37, 45	-0-101	✓
	5, 21, 13, 29	0--101	✓
	5, 21, 37, 45	--0101	✓
	5, 21, 13, 45	-0-101	✓
	5, 37, 21, 53	--0101	✓
3	13, 29, 45, 61	--1101	✓
	13, 45, 29, 61	--1101	
	21, 29, 45, 31	01-1-1	P3
	21, 29, 53, 61	-1-101	✓
	21, 53, 29, 61	-1-101	✓
	37, 53, 45, 61	1-1-101	✓
每次	5, 13, 37, 29, 21, 45	---101	
	53, 61		
	5, 13, 21, 29	-1--101	P4
	37, 53, 45, 61		
	5, 37, 21, 53	---101	
	13, 29, 45, 61		

24, 28, 44, 56, 18, 29, 31, 37, 53, 45, 61

	1	5	9	13	21	23	31	37	45	53	61	29
P1 (21, 23)					X	X						
P2 (5, 9, 13)	X	X	X	X								
P3 (21, 29, 45, 61)					X	X	X					X
P4 (5, 13, 21, 29, 37, 53, 45, 61)	X			X	X			X	X	X	X	X

$P2 + P3 + P4$ $P2 \cdot P3 \cdot P4$

$\therefore F(u, v, w, x, y, z) = 00--01 + 01-1-1 + ---101$
 $= \bar{u}\bar{v}\bar{y}z + \bar{u}v\bar{x}z + x\bar{y}z$