第二章布置习题参考解

2-1

a) 用真值表验证　XYZ=X+Y+Z　三变量 DeMorgan 定律

X	Y	Z	XYZ	$\overline{XYZ}$	$\overline{X}+\overline{Y}+\overline{Z}$
0	**0**	**0**	**0**	**1**	**1**
0	**0**	**1**	**0**	**1**	**1**
0	**1**	**0**	**0**	**1**	**1**
0	**1**	**1**	**0**	**1**	**1**
1	**0**	**0**	**0**	**1**	**1**
1	**0**	**1**	**0**	**1**	**1**
1	**1**	**0**	**0**	**1**	**1**
1	**1**	**1**	**1**	**0**	**0**

2-2 用代数化简来证明下列布尔函数的性质

a) $\overline{X}\,\overline{Y} + \overline{X}Y + XY = \overline{X} + Y$

$$\overline{X}\,\overline{Y} + \overline{X}Y + XY = (\overline{X}\,\overline{Y} + \overline{X}Y) + (\overline{X}Y + XY)$$
$$= \overline{X}(\overline{Y} + Y) + Y(\overline{X} + X)$$
$$= \overline{X} + Y$$

c) $Y + \overline{X}Z + X\overline{Y} = X + Y + Z$

$$Y + \overline{X}Z + X\overline{Y} = Y + X\overline{Y} + \overline{X}Z$$
$$= (Y + X)(Y + \overline{Y}) + \overline{X}Z$$
$$= Y + X + \overline{X}Z$$
$$= Y + (X + \overline{X})(X + Z)$$
$$= X + Y + Z$$

2-3 用代数化简来证明下列布尔函数的性质

a) $AB\overline{C}+B\overline{C}\,\overline{D}+BC+\overline{C}D=B+\overline{C}D$

$$
\begin{aligned}
&AB\overline{C}+B\overline{C\overline{D}}+BC+\overline{C}D\\
&=AB\overline{C}+B(\overline{C}+\overline{D})+BC+\overline{C}D\\
&=AB\overline{C}+B\overline{C}+B\overline{D}+BC+\overline{C}D\\
&=AB\overline{C}+B(\overline{C}+C)+B\overline{D}+\overline{C}D\\
&=AB\overline{C}+B+B\overline{D}+\overline{C}D\\
&=B(1+A\overline{C}+\overline{D})+\overline{C}D\\
&=B+\overline{C}D
\end{aligned}
$$

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

$$
\begin{aligned}
&A\overline{D}+\overline{A}B+\overline{C}D+\overline{B}C\\
&=\overline{\overline{A\overline{D}+\overline{A}B+\overline{C}D+\overline{B}C}}\\
&=\overline{(\overline{A}+D)(C+\overline{D})(A+\overline{B})\overline{B}C}\\
&=\overline{(\overline{A}C+\overline{A}\,\overline{D}+CD)(B+\overline{C})(A+\overline{B})}\\
&=\overline{(\overline{A}BC+\overline{A}B\overline{D}+BCD+\overline{A}\,\overline{C}\,\overline{D})(A+\overline{B})}\\
&=\overline{ABCD+\overline{A}\,\overline{B}\,\overline{C}\,\overline{D}}\\
&=(\overline{A}+\overline{B}+\overline{C}+\overline{D})(A+B+C+D)
\end{aligned}
$$

2-6 化简下列布尔表达式，使表达式中包含的变量最少

b) $(\overline{A+B+C})\bullet\overline{ABC}$

$$
\begin{aligned}
&=\overline{A}\,\overline{B}\,\overline{C}\bullet\overline{ABC}\\
&=\overline{A}\,\overline{B}\,\overline{C}\bullet(\overline{A}+\overline{B}+\overline{C})\\
&=\overline{A}\,\overline{B}\,\overline{C}
\end{aligned}
$$

d) $\overline{A}\,\overline{B}D+\overline{A}\,\overline{C}D+BD=D(\overline{A}\,\overline{B}+B)+\overline{A}\,\overline{C}D$

$$
\begin{aligned}
&=\overline{A}D+DB+\overline{A}\,\overline{C}D=\overline{A}D(1+\overline{C})+DB\\
&=\overline{A}D+DB=D(\overline{A}+B)
\end{aligned}
$$

2-10

a) $(XY+Z)(Y+XZ)$

XYZ	F
000	0
001	0
010	0
011	1
100	0
101	1
110	1
111	1

$$
\begin{aligned}
F &= (XY + Z)(Y + XZ) \\
&= (X + Z)(Y + Z)(Y + X)(Y + Z) \\
&= (X + Z) + Y\bar{Y})(Y + Z + X\,\bar{X})(Y + X + Z\bar{Z}) \\
&= (X + Y + Z)(X + Z + \bar{Y})(Y + Z + X) \\
&\qquad (Y + Z + \bar{X})(Y + X + Z)(Y + X + \bar{Z}) \\
&= (X + Y + Z)(X + \bar{Y} + Z)(\bar{X} + Y + Z)(X + Y + \bar{Z}) \\
&= \bar{X}YZ + X\bar{Y}Z + XY\bar{Z} + XYZ
\end{aligned}
$$

c)

WXYZ	F
0000	0
0001	0
0010	1
0011	0
0100	0
0101	0
0110	1
0111	0
1000	0
1001	0
1010	1
1011	0
1100	1
1101	1
1110	1
1111	1

$$\bar{W}\bar{X}Y\bar{Z} + \bar{W}XY\bar{Z} + W\bar{X}Y\bar{Z} + WX\bar{Y}\bar{Z} + WX\bar{Y}Z + WXY\bar{Z} + WXYZ$$

$$(W + X + Y + Z)(W + X + Y + \bar{Z})(W + X + \bar{Y} + \bar{Z})$$

$$(W + \bar{X} + Y + Z)(W + \bar{X} + Y + \bar{Z})(W + \bar{X} + \bar{Y} + \bar{Z})$$

$$(\bar{W} + X + Y + Z)(\bar{W} + X + Y + \bar{Z})(\bar{W} + X + \bar{Y} + \bar{Z})$$

2-11

a) $E = \sum m(1,2,4,6) = \prod M(0,3,5,7)$ $\qquad F = \sum m(0,2,4,7) = \prod M(1,3,5,6)$

c) $E + F = \sum m(0,1,2,4,6,7)$ $\qquad E \bullet F = \sum m(2,4)$

d) $E = \bar{X}\bar{Y}Z + \bar{X}Y\bar{Z} + X\bar{Y}\bar{Z} + XY\bar{Z}$ $\qquad F = \bar{X}\bar{Y}\bar{Z} + \bar{X}Y\bar{Z} + X\bar{Y}\bar{Z} + XYZ$

$= \bar{X}\bar{Y}Z + X\bar{Z} + Y\bar{Z}$ $\qquad = \bar{Y}\bar{Z} + \bar{X}\bar{Z} + XYZ$

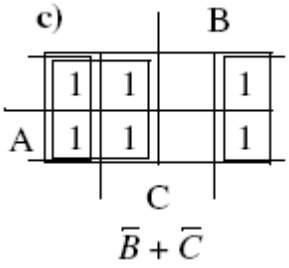
2-12

$$\bar{X} + X(X + \bar{Y})(Y + \bar{Z}) = (\bar{X} + X)\big(\bar{X} + (X + \bar{Y})(Y + \bar{Z})\big)$$

$$= (\bar{X} + X + \bar{Y})(\bar{X} + Y + \bar{Z})$$

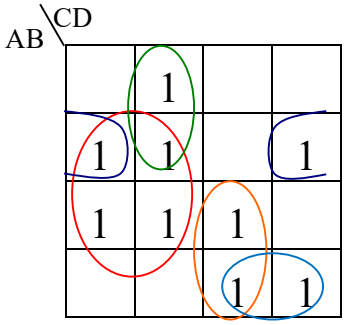
b) $= (1 + \bar{Y})(\bar{X} + Y + \bar{Z}) = \bar{X} + Y + \bar{Z}$ s.o.p / p.o.s

2-15



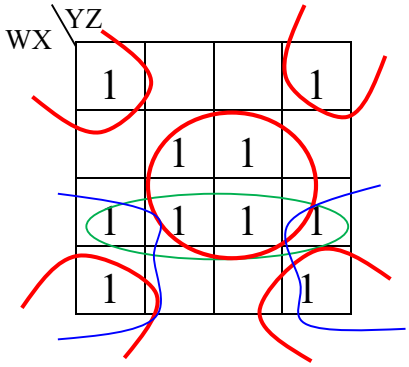
$\overline{B} + \overline{C}$

2-17



b) $F = B\overline{C} + \overline{A}\,\overline{C}D + \overline{A}B\overline{D} + ACD + A\overline{B}C$

2-19



a) Prime implicants: WX, XZ, $\overline{X}\overline{Z}$, W$\overline{Z}$

Essential prime implicants: XZ, $\overline{X}\overline{Z}$

2-22 (a)

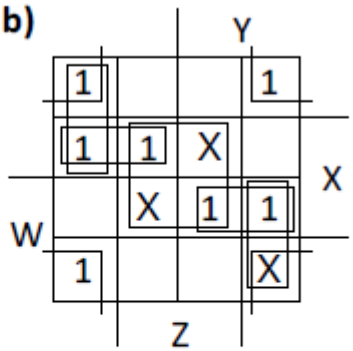
AB \ CD	00	01	11	10
00		1	1	
01			1	
11	1	1	1	
10	1	1	1	

$A\bar{C} + CD + \bar{B}D$ (s.o.p.)
$(\bar{C} + D)(A + D)(A + \bar{B} + C)$ (p.o.s.)

Or
$A\bar{C} + \bar{B}D + \bar{A}CD + ABCD$
$=A(\bar{C} + BCD) + \bar{B}D + \bar{A}CD$
$=A\bar{C} + ABD + \bar{B}D + \bar{A}CD$
$=A\bar{C} + AD + \bar{B}D + \bar{A}CD$
$=A\bar{C} + AD + \bar{B}D + CD$
$=A\bar{C} + AD + CD + \bar{B}D$
$=A\bar{C} + CD + \bar{B}D$ (s.o.p.)

2-25

b)



$Primes = \bar{X}\bar{Z},\ XZ,\ \bar{W}X\bar{Y},\ WXY,\ \bar{W}\bar{Y}\bar{Z},\ WY\bar{Z}$

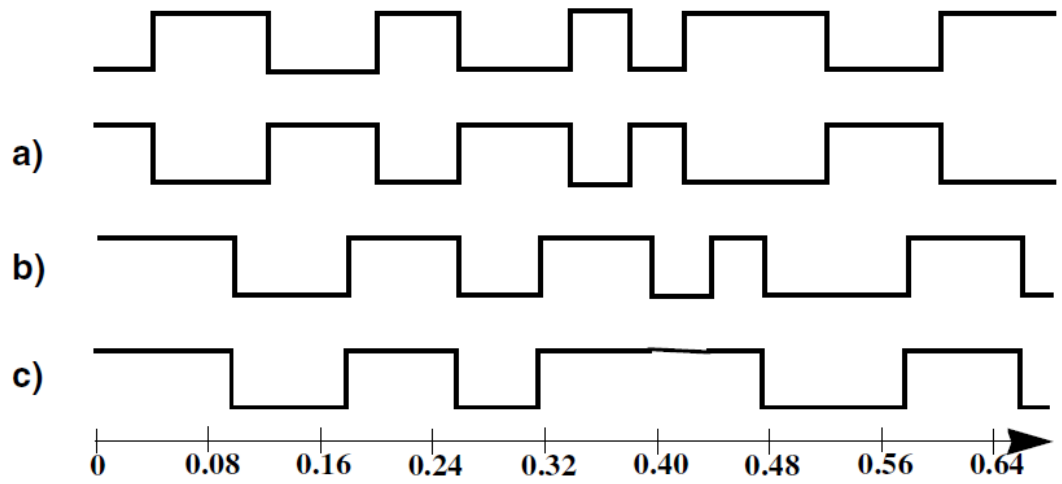
$Essential = \bar{X}\bar{Z}$

$F = \bar{X}\bar{Z} + \bar{W}X\bar{Y} + WXY$

2-29

The longest path is from input C or $\bar{D}$.
0.073 ns + 0.073 ns + 0.048 ns + 0.073 ns = 0.267 ns

2-30



2-31

	a)	b)
Input	Delay t_{pd}	Delay t_{pd}
C	1.12ns	1.12ns
D	1.12ns	1.12ns
$\overline{B}$	0.84ns	0.84ns
A	0.56ns	0.56ns
B	0.56ns	0.56ns
$\overline{C}$	0.56ns	0.56ns

c) They are the same.