第二章布置习题参考解

2-1

a) 用真值表验证 $\overline{XYZ}=\overline{X}+\overline{Y}+\overline{Z}$ 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) $\overline{X}\overline{Y}+\overline{X}Y+XY=\overline{X}+Y$

$$\begin{aligned}&\overline{X}\overline{Y}+\overline{X}Y+XY=(\overline{X}\overline{Y}+\overline{X}Y)+(\overline{X}Y+XY)\\&=\overline{X}(\overline{Y}+Y)+Y(\overline{X}+X)\\&=\overline{X}+Y\end{aligned}$$

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

$$\begin{aligned}&Y+\overline{X}Z+X\overline{Y}=Y+X\overline{Y}+\overline{X}Z\\&=(Y+X)(Y+\overline{Y})+\overline{X}Z\\&=Y+X+\overline{X}Z\\&=Y+(X+\overline{X})(X+Z)\\&=X+Y+Z\end{aligned}$$

2-3 用代数化简来证明下列布尔函数的性质

a) $A\bar{B}\bar{C}+B\bar{C}\bar{D}+BC+\bar{C}D=B+\bar{C}D$

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

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

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

2-6 化简下列布尔表达式，使表达式中包含的变量最少

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

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

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

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

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

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

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

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

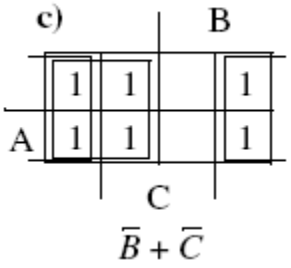
2-12

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

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

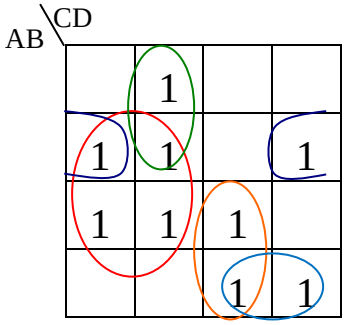
$= (1 + \bar{Y})(\bar{X} + Y + \bar{Z}) = \bar{X} + Y + \bar{Z}$ s.o.p.

2-15



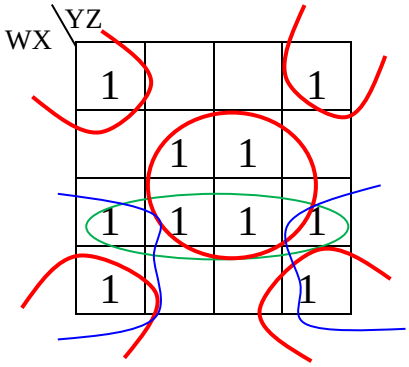
$\bar{B} + \bar{C}$

2-17



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

2-19



a) $Prime = WX, XZ, \bar{X}\bar{Z}, W\bar{Z}$

$Essential XZ, \bar{X}\bar{Z}$

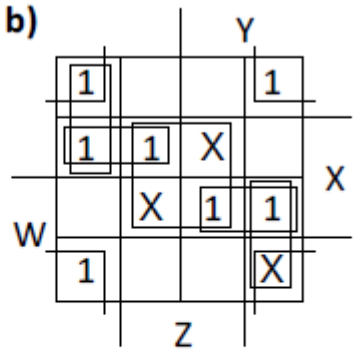
2-22 (a)

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



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

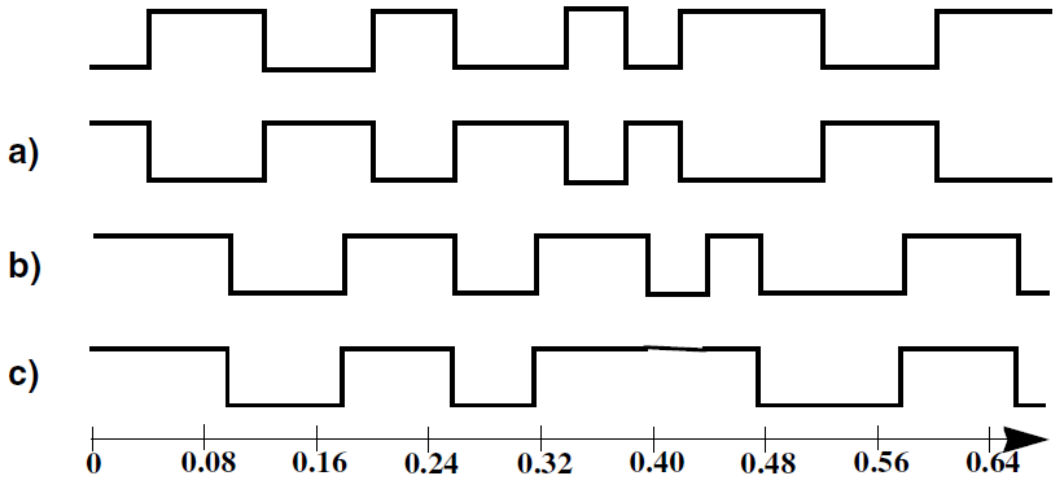
$Essential = \overline{XZ}$

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

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.