QUESTION#1:

(a) TRUTH TABLE:

	a_2	a_1	a_0	b_2	b_1	b_0
0	0	0	0	0	1	1
1	0	0	1	1	0	0
2	0	1	0	1	0	1
3	0	1	1	1	1	0
4	1	0	0	1	1	1
5	1	0	1	1	1	1
6	1	1	0	1	1	1
7	1	1	1	1	1	1

(b) Simplification for b_0:

	$\bar{a}_1\bar{a}_0$	$\bar{a}_1 a_0$	$a_1 a_0$	$a_1\bar{a}_0$
$\bar{a}_2$	1	0	0	1
a_2	1	1	1	1

$$b_0(a_2, a_1, a_0) = a_2 + \bar{a}_0$$

Simplification for b_1:

	$\bar{a}_1\bar{a}_0$	$\bar{a}_1 a_0$	$a_1 a_0$	$a_1\bar{a}_0$
$\bar{a}_2$	1	0	1	0
a_2	1	1	1	1

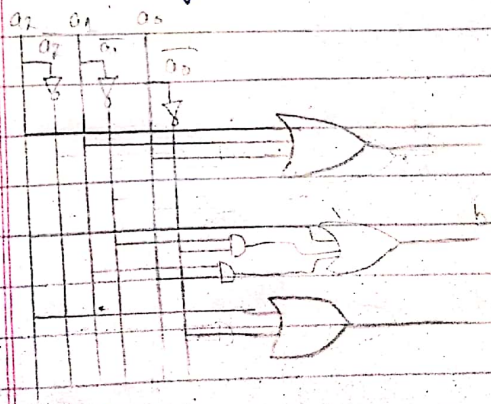
$$b_1(a_2, a_1, a_0) = a_2 + \bar{a}_1\bar{a}_0 + a_1 a_0$$

Simplification for b_2:

	$\bar{a}_1\bar{a}_0$	$\bar{a}_1 a_0$	$a_1 a_0$	$a_1\bar{a}_0$
$\bar{a}_2$	0	1	1	1
a_2	1	1	1	1

$$b_2(a_2, a_1, a_0) = a_2 + a_1 + a_0$$

(c) Circuit Diagram:



QUESTION # 2

(a) TRUTH TABLE:

	a_2	a_1	a_0	out
0	0	0	0	0
1	0	0	1	0
2	0	1	0	0
3	0	1	1	1
4	1	0	0	0
5	1	0	1	1
6	1	1	0	1
7	1	1	1	1

(b) Simplification of out using K-maps:

	$\bar{a}_1\bar{a}_0$	$\bar{a}_1 a_0$	$a_1 a_0$	$a_1\bar{a}_0$
$\bar{a}_2$	0	0	1	0
a_2	0	1	1	1

$out(a_2, a_1, a_0) = a_2a_0 + \bar{a}_2a_1 + a_1a_0$

(c) Circuit Diagram:

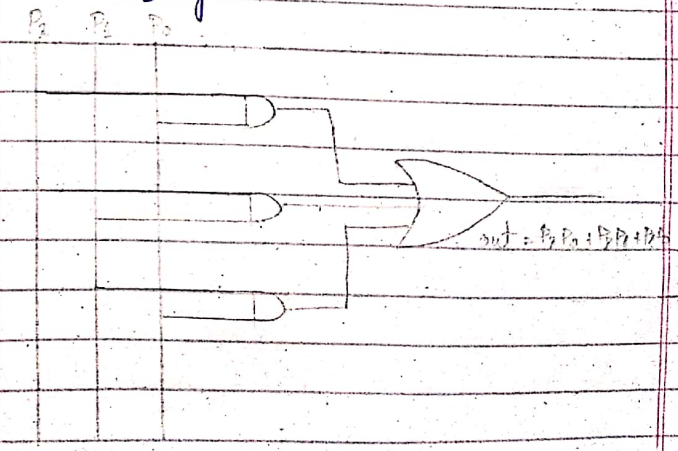
QUESTION # 3

	P_2	P_1	P_0	out
0	0	0	0	0
1	0	0	1	0
2	0	1	0	0
3	0	1	1	1
4	1	0	0	0
5	1	0	1	1
6	1	1	0	1
7	1	1	1	1

	$\bar{P}_1\bar{P}_0$	$\bar{P}_1P_0$	P_1P_0	$P_1\bar{P}_0$
$\bar{P}_2$	0	0	1	0
P_2	0	1	1	1

$out(P_2, P_1, P_0) = P_2P_0 + P_2P_1 + P_1P_0$

Circuit Diagram:



QUESTION #4:

Truth Table:

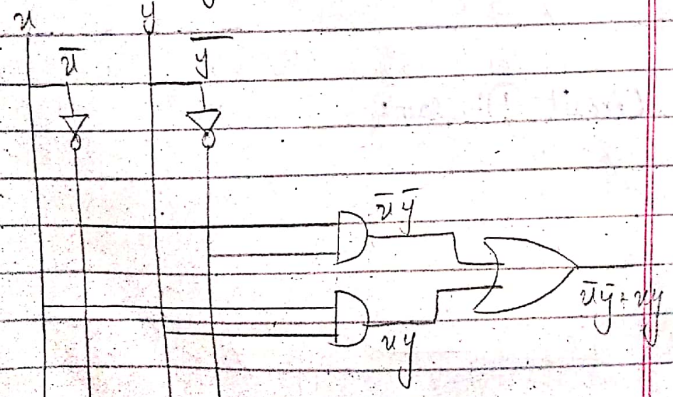
x	y	Light(x,y)	
0	0	1	$\bar{x}\bar{y}$
0	1	0	$\bar{x}y$
1	0	0	$x\bar{y}$
1	1	1	xy

$Light(x,y) = \Sigma m(0,3)$

$= m_0 + m_3$

$= \bar{x}\bar{y} + xy$

Circuit Diagram:



QUESTION #5:

Truth Table:

x	y	z	a_6	a_5	a_4	a_3	a_2	a_1
0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	1
0	1	0	0	0	0	1	0	0
0	1	1	0	0	1	0	0	1
1	0	0	0	1	0	0	0	0
1	0	1	0	1	1	0	0	1
1	1	0	1	0	0	1	0	0
1	1	1	1	1	0	0	0	1

Simplification using K-Map.

a_6:

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	0	0	0	0
x	0	0	1	1

$a_6(x,y,z) = xy$

a_4:

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	0	0	1	0
x	0	1	0	0

$a_4(x,y,z) = \bar{x}yz + x\bar{y}z$

$a_4(x,y,z) = z(\bar{x}y + x\bar{y})$

$= z(x \oplus y)$

a_5:

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{u}$	0	0	0	0
u	1	1	1	0

$a_5(u,y,z) = u\bar{y} + uz$

a_3:

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{u}$	0	0	0	1
u	0	0	0	1

$a_3(u,y,z) = y\bar{z}$

a_2:

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{u}$	0	0	0	0
u	0	0	0	0

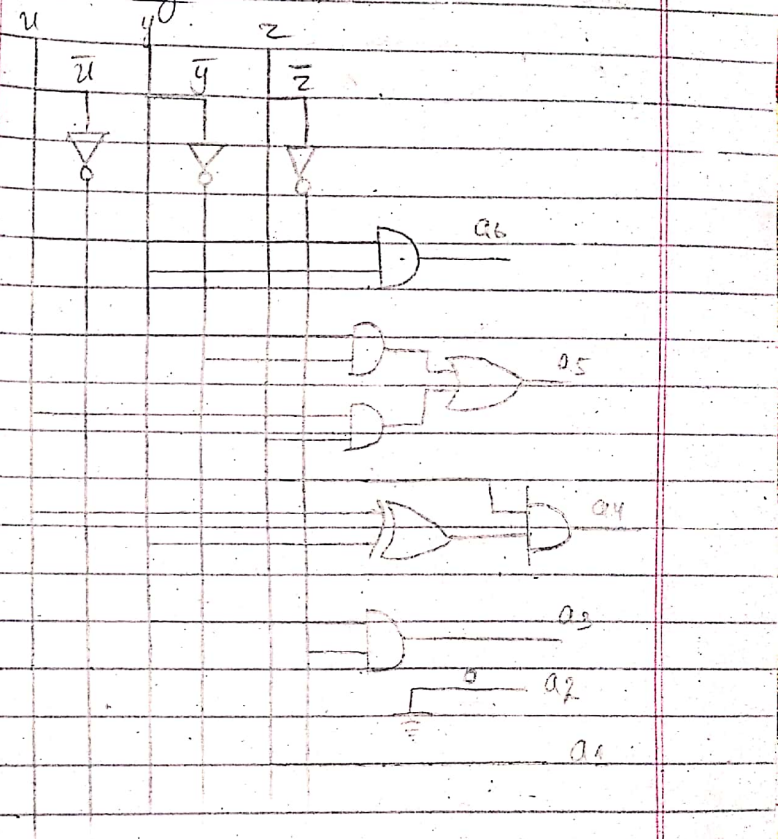
$a_2(u,y,z) = 0$

a_1:

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{u}$	0	1	1	0
u	0	1	1	0

$a_1(u,y,z) = z$

Circuit Diagram:

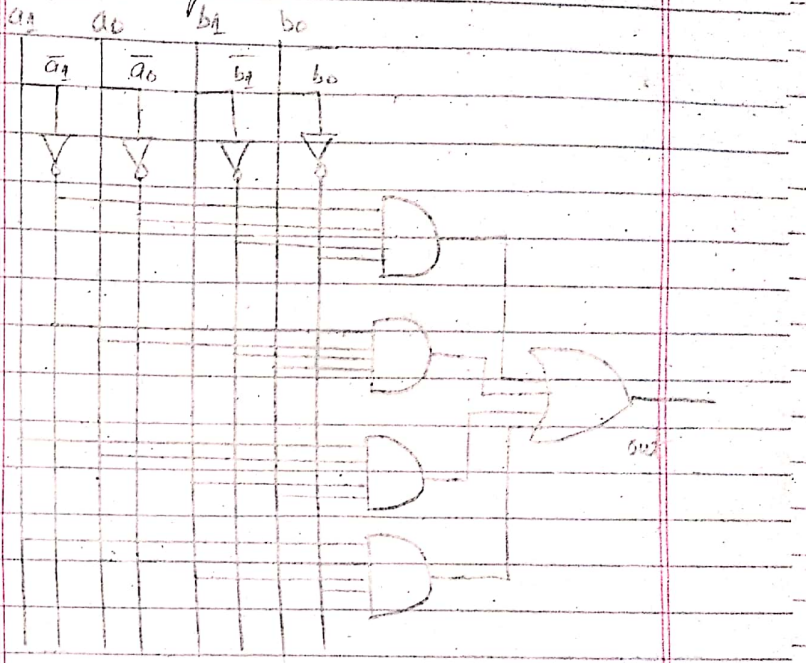


QUESTION #6:

	A		B		Out
	a_1	a_0	b_1	b_0	
0	0	0	0	0	1
1	0	0	0	1	0
2	0	0	1	0	0
3	0	0	1	1	0
4	0	1	0	0	0
5	0	1	0	1	1
6	0	1	1	0	0
7	0	1	1	1	0
8	1	0	0	0	0
9	1	0	0	1	0
10	1	0	1	0	1
11	1	0	1	1	0
12	1	1	0	0	0
13	1	1	0	1	0
14	1	1	1	0	0
15	1	1	1	1	1

	$\bar{b}_1\bar{b}_0$	$\bar{b}_1 b_0$	$b_1 b_0$	$b_1\bar{b}_0$	
$\bar{a}_1\bar{a}_0$	(1)	0	0	0	$Out = \bar{a}_1\bar{a}_0\bar{b}_1\bar{b}_0 +$
$\bar{a}_1 a_0$	0	(1)	0	0	$\bar{a}_1 a_0 \bar{b}_1 b_0 +$
$a_1 a_0$	0	0	(1)	0	$a_1 a_0 b_1 b_0 +$
$a_1\bar{a}_0$	0	0	0	(1)	$a_1\bar{a}_0 + b_1\bar{b}_0$

Circuit Diagram:



QUESTION #7

	w	x	y	z	a	b	c	d
0	0	0	0	0	0	0	0	0
1	0	0	0	1	1	1	1	1
2	0	0	1	0	1	1	1	0
3	0	0	1	1	1	1	0	1
4	0	1	0	0	1	1	0	0
5	0	1	0	1	1	0	1	1
6	0	1	1	0	1	0	1	0
7	0	1	1	1	1	0	0	1
8	1	0	0	0	1	0	0	0
9	1	0	0	1	0	1	1	1
10	1	0	1	0	0	1	1	0
11	1	0	1	1	0	1	0	1
12	1	1	0	0	0	1	0	0
13	1	1	0	1	0	0	1	1
14	1	1	1	0	0	0	1	0
15	1	1	1	1	0	0	0	1

Simplification using k-Maps:

a)

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{w}\bar{x}$	0	1	1	0
$\bar{w}x$	1	1	1	1
wx	0	0	0	0
$w\bar{x}$	1	0	0	0

$a(w,x,y,z) = \bar{w}x + \bar{w}z + \bar{w}y + \bar{x}\bar{z}$

b)

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{w}\bar{x}$	0	1	1	1
$\bar{w}x$	1	0	0	0
wx	1	0	0	0
$w\bar{x}$	0	1	1	1

$b(w,x,y,z) = \bar{x}y + \bar{x}z + x\bar{y}\bar{z}$

c)

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{w}\bar{x}$	0	1	0	1
$\bar{w}x$	0	1	0	1
wx	0	1	0	1
$w\bar{x}$	0	1	0	1

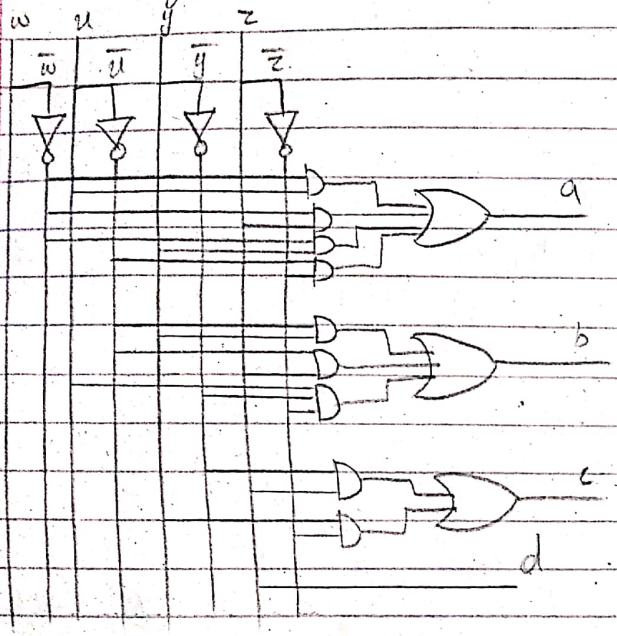
$c(w,x,y,z) = \bar{y}z + y\bar{z}$

d)

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{w}\bar{x}$	0	1	1	0
$\bar{w}x$	0	1	1	0
wx	0	1	1	0
$w\bar{x}$	0	1	1	0

$d(w,x,y,z) = z$

Circuit Diagram:



QUESTION # 8:

	T	D	L	A
0	0	0	0	0
1	0	0	1	0
2	0	1	0	0
3	0	1	1	0
4	1	0	0	0
5	1	0	1	1
6	1	1	0	1
7	1	1	1	1

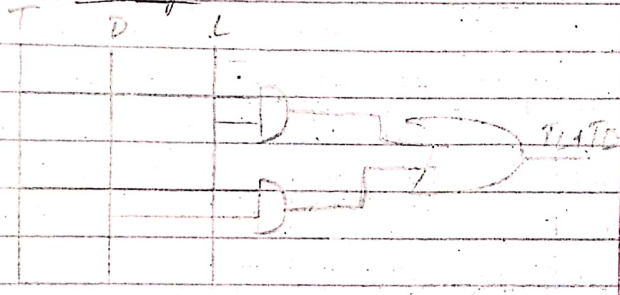
Night = 1
Door open = 1
Laser light disturbed = 1
Day = 0
Door closed = 0
Laser light not disturbed = 0
Alarm ON = 1
Alarm OFF = 0

K-Map for simplifications:

	$\bar{D}\bar{L}$	$\bar{D}L$	DL	$D\bar{L}$
$\bar{T}$	0	0	0	0
T	0	1	1	1

$A(T,D,L) = TL + TD$

Circuit Diagram:



QUESTION # 9:

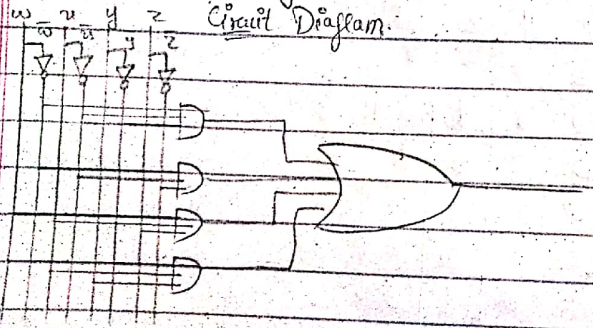
	w	x	y	z	out
0	0	0	0	0	1
1	0	0	0	1	1
2	0	0	1	0	1
3	0	0	1	1	0
4	0	1	0	0	0
5	0	1	0	1	0
6	0	1	1	0	0
7	0	1	1	1	0

8	1	0	0	0	0
9	1	0	0	1	0
10	1	0	1	0	0
11	1	0	1	1	0
12	1	1	0	0	0
13	1	1	0	1	1
14	1	1	1	0	1
15	1	1	1	1	1

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{w}\bar{v}$	1	1	0	1
$\bar{w}v$	0	0	0	0
wv	0	1	1	1
$w\bar{v}$	0	0	0	0

$F(w,v,y,z) = \bar{w}\bar{v}\bar{y} + \bar{w}\bar{v}\bar{z} + wvz + wvy$

Circuit Diagram:



QUESTION# 10:

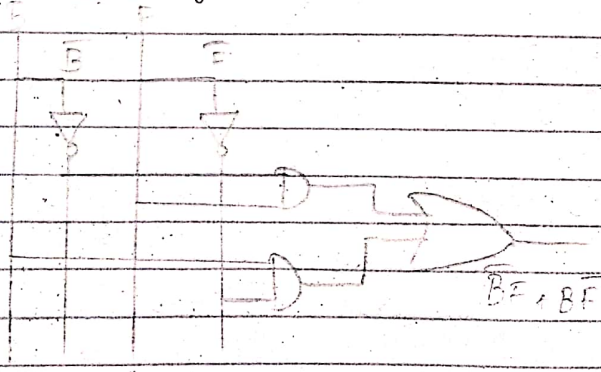
Truth Table:

B	F	O
0	0	0
0	1	1
1	0	1
1	1	0

	$\bar{F}$	F
$\bar{B}$	0	1
B	1	0

$O(B,F) = \bar{B}F + B\bar{F}$

Circuit Diagram:



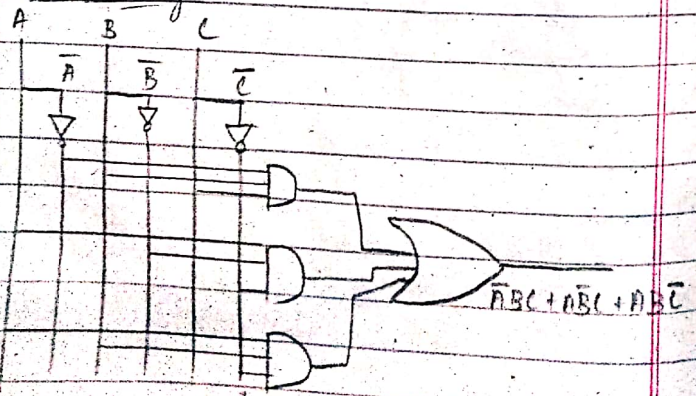
QUESTION #11:

	A	B	C	Out
0	0	0	0	0
1	0	0	1	0
2	0	1	0	0
3	0	1	1	1
4	1	0	0	0
5	1	0	1	1
6	1	1	0	1
7	1	1	1	0

	$\bar{B}\bar{C}$	$\bar{B}C$	BC	$B\bar{C}$
$\bar{A}$	0	0	1	0
A	0	1	0	1

$Out(A,B,C) = \bar{A}BC + A\bar{B}C + AB\bar{C}$

Circuit Diagram:



QUESTION #12:

(a) $F(x,y,z) = \Sigma m(2,3,6,7)$

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	0	0	1	1
x	0	0	1	1

$F(x,y,z) = y$

(b) $F(A,B,C,D) = \Sigma m(7,13,14,15)$

	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	0	0	0	0
$\bar{A}B$	0	0	1	0
AB	0	1	1	1
$A\bar{B}$	0	0	0	0

$F(A,B,C,D) = ABD + ABC + BCD$

(c) $F(A,B,C,D) = \Sigma m(4,6,7,15)$

	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	0	0	0	0
$\bar{A}B$	1	0	1	1
AB	0	0	1	0
$A\bar{B}$	0	0	0	0

$F(A,B,C,D) = \bar{A}B\bar{D} + BCD$

(d) $F(w,u,y,z) = \Sigma m(2,3,12,13,14,15)$

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{w}\bar{u}$	0	0	1	1
$\bar{w}u$	0	0	0	0
wu	1	1	1	1
$w\bar{u}$	0	0	0	0

$$F(w,u,y,z) = wu + \bar{w}\bar{u}y.$$

(e) $F(u,y,z) = uy + \bar{u}\bar{y}\bar{z} + \bar{u}y\bar{z}$

$= uy(z+\bar{z}) + \bar{u}\bar{y}\bar{z} + \bar{u}y\bar{z}$

$= uyz + uy\bar{z} + \bar{u}\bar{y}\bar{z} + \bar{u}y\bar{z}$

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{u}$	1	0	0	1
u	0	0	1	1

$$F(u,y,z) = \bar{u}\bar{z} + uy.$$

(f) $F(A,B,C) = \bar{A}B + B\bar{C} + \bar{B}\bar{C}$

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

$= \bar{A}BC + \bar{A}B\bar{C} + \bar{A}\bar{B}\bar{C} + AB\bar{C} + A\bar{B}\bar{C} + \bar{A}\bar{B}\bar{C}$

	$\bar{B}C$	$\bar{B}\bar{C}$	BC	$B\bar{C}$
$\bar{A}$	1	0	1	1
A	1	0	0	1

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

(g) $F(a,b,c) = \bar{a}\bar{b} + bc + \bar{a}b\bar{c}$

$= \bar{a}\bar{b}(c+\bar{c}) + bc(a+\bar{a}) + \bar{a}b\bar{c}$

$= \bar{a}\bar{b}c + \bar{a}\bar{b}\bar{c} + abc + \bar{a}bc + \bar{a}b\bar{c}$

	$\bar{b}\bar{c}$	$\bar{b}c$	bc	$b\bar{c}$
$\bar{a}$	1	1	1	1
a	0	0	1	0

$$F(a,b,c) = \bar{a} + bc$$

(h) $F(x,y,z) = xyz + xy\bar{z} + \bar{x}yz + xyz$

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	0	0	1	0
x	0	1	1	1

$F(x,y,z) = x\bar{z} + xy + yz.$

QUESTION # 13:

(a) $F(x,y,z) = \Pi M(0,1,4,5)$

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	0	0	1	1
x	0	0	1	1

$F(x,y,z) = \bar{y}$

$F(x,y,z) = \bar{\bar{y}} = y$

(b) $F(A,B,C,D) = \Pi M(0,1,2,3,4,10,11)$

	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	0	0	0	0
$\bar{A}B$	0	1	1	1
AB	1	1	1	1
$A\bar{B}$	1	1	0	0

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

$F(A,B,C,D) = (\bar{A}\bar{B}) + (BC) + (\bar{A}C\bar{D})$

$F(A,B,C,D) = (A+B)\cdot(B+\bar{C})\cdot(A+C+D).$

(c) $F(w,x,y,z) = \Pi M(1,3,5,7,13,15)$

	$\bar{y}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{w}\bar{x}$	1	0	0	1
$\bar{w}x$	1	0	0	1
wx	1	0	0	1
$w\bar{x}$	1	1	1	1

$F(w,x,y,z) = \bar{w}z + x\bar{z}$

$F(w,x,y,z) = \overline{\bar{w}z + xz}$

$F(w,x,y,z) = (w+\bar{z})\cdot(\bar{x}+\bar{z})$

QUESTION #14:

(a) $F(x,y,z) = \bar{x}\bar{z} + \bar{y}\bar{z} + y\bar{z} + xyz$

	$\bar{x}\bar{z}$	$\bar{y}z$	yz	$y\bar{z}$
$\bar{x}$	1	0	0	1
x	1	0	1	1

(i) $F(x,y,z) = \bar{z} + xy.$

(ii) $\overline{F(x,y,z)} = \bar{y}z + \bar{x}z$

$F(x,y,z) = \overline{\bar{x}z + \bar{y}z}$

$F(x,y,z) = (x+\bar{z}) \cdot (y+\bar{z})$

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

Taking Functions complement we get

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

Now plotting these on k-Map as (0) and rest boxes (1)

	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	0	1	0	1
$\bar{A}B$	0	1	0	0
AB	0	1	0	1
$A\bar{B}$	0	1	0	0

(i) $F(A,B,C,D) = \bar{C}D + \bar{A}\bar{B}C\bar{D} + AB\bar{C}\bar{D}$

(ii) $\overline{F(A,B,C,D)} = \overline{\bar{C}D + CD + \bar{A}B\bar{D} + A\bar{B}\bar{D}}$

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

$F(A,B,C,D) = (C+D)\cdot(\bar{C}+\bar{D})\cdot(A+\bar{B}+D)$
$\cdot\ (\bar{A}+B+D)$

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

Taking Functions complement then Map on k-Map for '0'

$\overline{F(A,B,C,D)} = (ABD) + (\bar{A}B\bar{C}) + (A\bar{B}\bar{D}) + (\bar{B}CD)$

	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	1	1	0	1
$\bar{A}B$	1	1	0	0
AB	1	0	0	1
$A\bar{B}$	1	0	0	1

(i) $F(A,B,C,D) = \bar{A}\bar{C} + C\bar{D} + A\bar{D} + \bar{B}\bar{D}$

(ii) $\overline{F(A,B,C,D)} = AD + CD + \bar{A}BC$

$F(A,B,C,D) = \overline{AD + CD + \bar{A}BC}$

$F(A,B,C,D) = (\bar{A}+\bar{D})\cdot(\bar{C}+\bar{D})\cdot(A+\bar{B}+C)$

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

Taking functions complement and then map on K-map for which its '0'.

$\overline{F(A,B,C,D)} = (AB\bar{D}) + (AD) + (\bar{A}BD) + (\bar{A}BC\bar{D})$

	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	1	0	0	1
$\bar{A}B$	0	1	1	1
AB	0	0	0	0
$A\bar{B}$	1	0	0	1

(i) $F(A,B,C,D) = \bar{B}\bar{D} + \bar{A}BC + \bar{A}BD$

(ii) $\overline{F(A,B,C,D)} = AD + \bar{B}D + ABC + B\bar{C}\bar{D}$

$F(A,B,C,D) = \overline{AD + \bar{B}D + ABC + B\bar{C}D}$

$F(A,B,C,D) = (\bar{A}+\bar{D})\cdot(B+\bar{D})\cdot(\bar{A}+\bar{B}+\bar{C})\cdot(\bar{B}+C+\bar{D})$

(e) $F(v,w,x,y) = \bar{w}y + v\bar{w} + v\bar{w}x + v\bar{w}\bar{x} + \bar{v}\bar{w}y$

	$\bar{x}\bar{y}$	$\bar{x}y$	xy	$x\bar{y}$
$\bar{v}\bar{w}$	1	1	1	1
$\bar{v}w$	1	1	1	1
vw	0	0	0	0
$v\bar{w}$	1	1	1	1

(i) $F(v,w,x,y) = \bar{v} + \bar{w}$

(ii) $\overline{F(v,w,x,y)} = vw$

$F(v,w,x,y) = \bar{v}\bar{w}$