1-2

Friday, 6 March 2020 3:50 pm

1. $X \oplus Y$

Dual: $X\bar{Y} + \bar{X}Y = (X+\bar{Y})(\bar{X}+Y)$

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

$= \overline{\bar{X}Y + X\bar{Y}}$

$= \overline{X \oplus Y}$

2. $F = AB\bar{C}D + A\bar{D} + \bar{A}D$

$= AB\bar{C}D + A \oplus D$

$= A \oplus D + \overline{A \oplus D} \cdot AB\bar{C}D$

$A + B = A + \bar{A}B$

$= A \oplus D(AB\bar{C}D + \overline{AB\bar{C}D}) + \overline{A \oplus D} \cdot AB\bar{C}D$

$= A \oplus D \cdot AB\bar{C}D + A \oplus D \cdot \overline{AB\bar{C}D} + \overline{A \oplus D} \cdot AB\bar{C}D$

$= A \oplus D \cdot AB\bar{C}D + A \oplus D \oplus AB\bar{C}D$

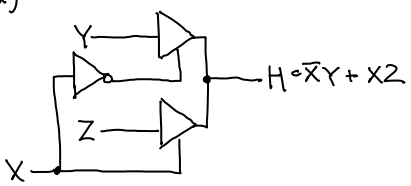
$= (\bar{A}D + A\bar{D}) \cdot AB\bar{C}D + A \oplus D \oplus AB\bar{C}D$

$= A \oplus D \oplus AB\bar{C}D$

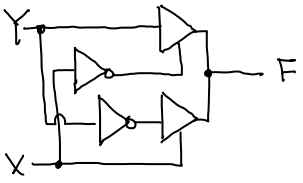
3-5

Friday, 6 March 2020 3:58 pm

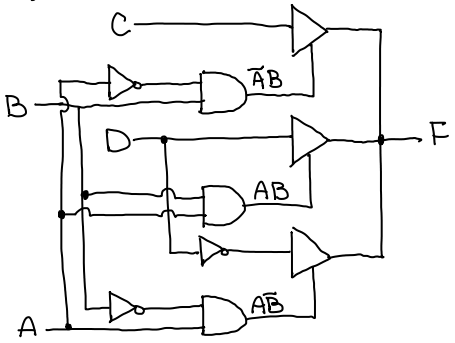
3a)



b) $F = X \oplus Y = X\bar{Y} + \bar{X}Y$



4. a)



b) No conflicts

5. for the tic-tac-toe grid:

X_1	X_2	X_3
X_4	X_5	X_6
X_7	X_8	X_9

a) for winning combinations:

$W = X_1X_2X_3 + X_4X_5X_6 + X_7X_8X_9 + X_1X_4X_7 + X_2X_5X_8 + X_3X_6X_9 + X_1X_5X_9 + X_3X_5X_7$

(GIC = 32)
literals = 24
terms = 8

b) $W = X_5(X_4X_6 + X_2X_8 + X_1X_9 + X_3X_7) + X_1(X_2X_3 + X_4X_7) + X_9(X_7X_8 + X_3X_6)$

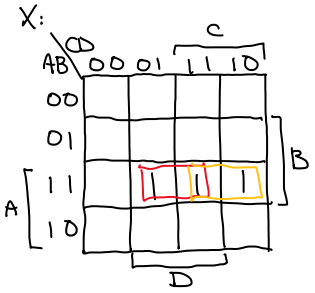
literals = 21
term = 10
(GIC = 31)

6

Friday, 6 March 2020 5:16 pm

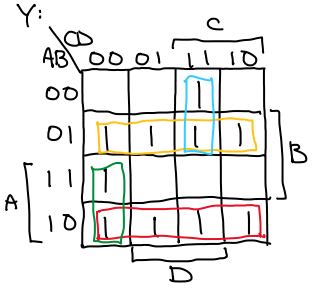
A	B	C	D	Decimal	$\sqrt{\text{Decimal}}$	X	Y	Z
0	0	0	0	0	0	0	0	0
0	0	0	1	1	1	0	0	1
0	0	1	0	2	1.41	0	0	1
0	0	1	1	3	1.	0	1	0
0	1	0	0	4	2	0	1	0
0	1	0	1	5	2.24	0	1	0
0	1	1	0	6	2.45	0	1	0
0	1	1	1	7	2.65	0	1	1
1	0	0	0	8	2.83	0	1	1
1	0	0	1	9	3	0	1	1
1	0	1	0	10	3.16	0	1	1
1	0	1	1	11	3.32	0	1	1
1	1	0	0	12	3.46	0	1	1
1	1	0	1	13	3.61	1	0	0
1	1	1	0	14	3.74	1	0	0
1	1	1	1	15	3.87	1	0	0

X:



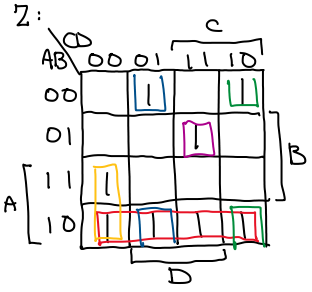
$X = ABD + ABC$

Y:



$Y = A\bar{B} + \bar{A}B + A\bar{C}\bar{D} + \bar{A}CD$

Z:



$Z = A\bar{B} + A\bar{C}\bar{D} + \bar{B}CD + \bar{B}C\bar{D}$
+

Friday, 6 March 2020 5:46 pm

Let $F_2 = X\bar{Y} + \bar{X}Y$

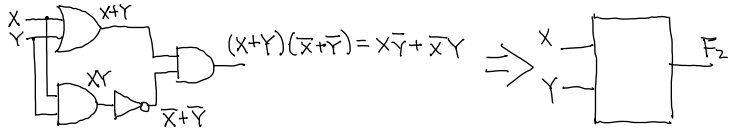
$\bar{F}_2 = \overline{X\bar{Y} + \bar{X}Y} = (\bar{X}+Y)(X+\bar{Y})$

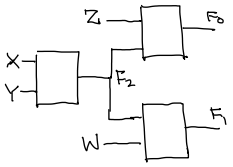
$= \bar{X}X + \bar{X}\bar{Y} + XY + Y\bar{Y}$

$= \bar{X}\bar{Y} + XY$

$\Rightarrow F_0 = Z\bar{F}_2 + \bar{Z}F_2$

$\Rightarrow F_1 = \bar{W}F_2 + W\bar{F}_2$





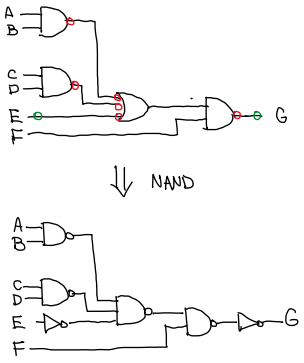
$F_0 = Z(XY + \bar{X}\bar{Y}) + \bar{Z}(\bar{X}Y + X\bar{Y})$

$F_1 = \bar{W}(\bar{X}Y + X\bar{Y}) + W(XY + \bar{X}\bar{Y})$

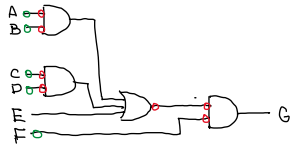
8-9

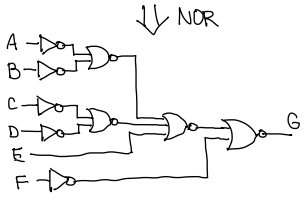
Friday, 6 March 2020 7:40 pm

8.



9. Repeat Q8 circuit using NOR gate.

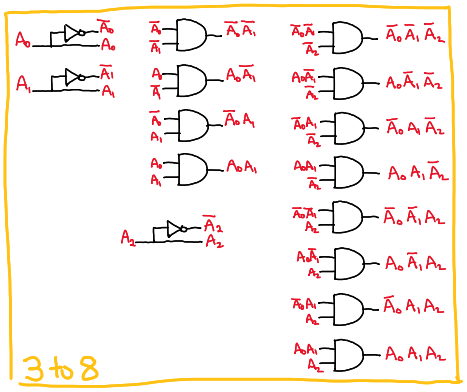


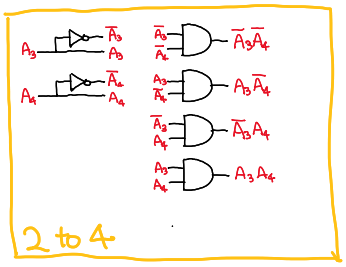


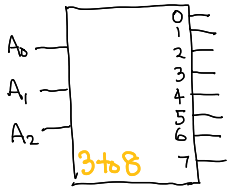
10

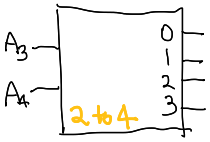
Friday, 6 March 2020 7:51 pm

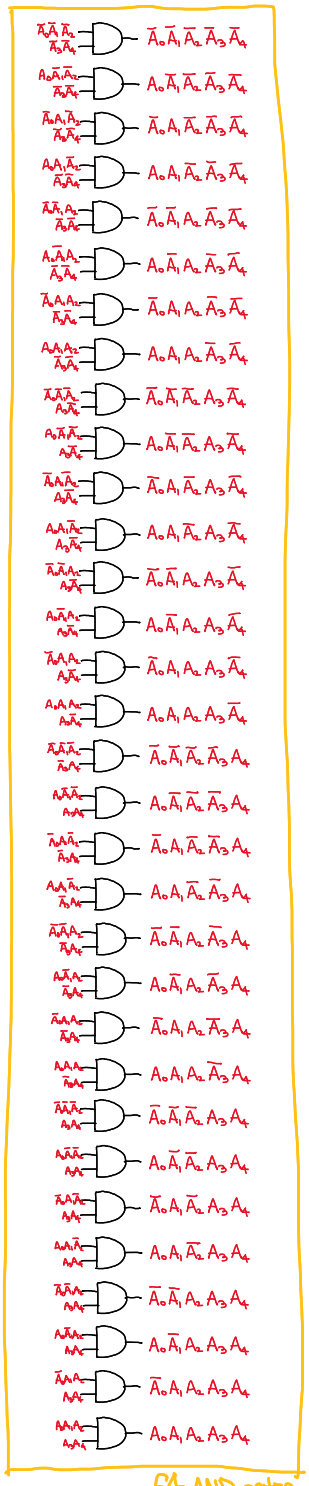
10.









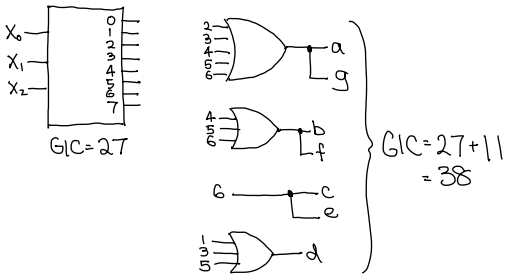


Friday, 6 March 2020 8:47 pm

a)

X_2	X_1	X_0	a	b	c	d	e	f	g	
0	0	0	X	X	X	X	X	X	X	m_0
0	0	1	0	0	0	1	0	0	0	m_1
0	1	0	1	0	0	0	0	0	1	m_2
0	1	1	1	0	0	1	0	0	1	m_3
1	0	0	1	1	0	0	0	1	1	m_4
1	0	1	1	1	0	1	0	1	1	m_5
1	1	0	1	1	1	0	1	1	1	m_6
1	1	1	X	X	X	X	X	X	X	m_7

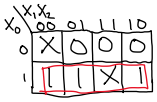
Note $a \equiv g$, $b \equiv f$, $c \equiv e$



b)

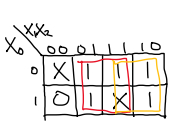
A = {d}
B = {a, g}
C = {c, e}
D = {b, f}

A:



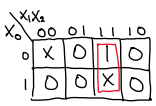
$A = X_0$

B:



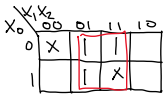
$B = X_1 + X_2$

C:



$C = X_1X_2$

D:



$D = X_2$

GIC=4

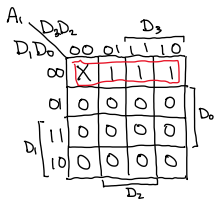
12-13

Friday, 6 March 2020 9:05 pm

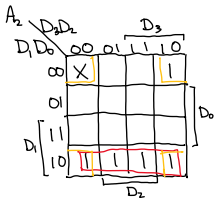
12.

D_3	D_2	D_1	D_0	A_1	A_2	V
0	0	0	0	X	X	0
X	X	X	1	0	0	1
X	X	1	0	0	1	1
X	1	0	0	1	0	1
1	0	0	0	1	1	1

$V = D_0 + D_1 + D_2 + D_3$

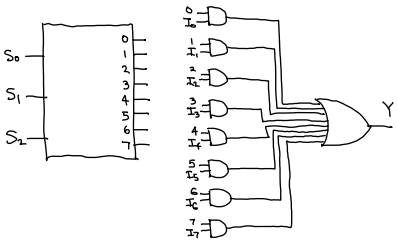


$A_1 = \bar{D}_1\bar{D}_0$



$A_0 = D_1\bar{D}_0 + \bar{D}_2\bar{D}_0$

13.



Friday, 6 March 2020 9:40 pm

$F_1 = \Sigma m(1,2,4)$

$F_2 = \bar{X}\bar{Y}\bar{Z} + YZ$

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

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

$= \Sigma m(0,3,7)$

$F_3 = YZ + XY$

$= (X+\bar{X})YZ + (Z+\bar{Z})XY$

$= XYZ + \bar{X}YZ + XY\bar{Z} + XY\bar{Z}$

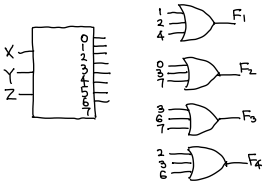
$= \Sigma m(3,6,7)$

$F_4 = \bar{X}Y + XYZ$

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

$= \bar{X}YZ + \bar{X}Y\bar{Z} + XY\bar{Z}$

$= \Sigma m(2,3,6)$



Friday, 6 March 2020 9:41 pm

a)

i) Left rear lamp (LR) will be ON and blinking (BL) when left turn switch (LT) or emergency flasher switch (EM) are ON. When break switch (BR) is applied, it will override emergency flasher switch (EM). When left turn switch (LT) is ON, break switch (BR) will be overridden.

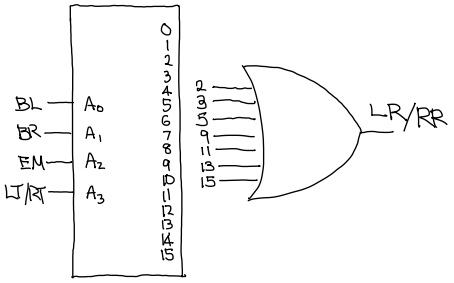
$$LR = BL(LT + EM \cdot \overline{BR}) + BR \cdot \overline{LT}$$

ii) Right rear lamp (RR) will be ON and blinking (BL) when right turn switch (RT) or emergency flasher switch (EM) are ON. When break switch (BR) is applied, it will override emergency flasher switch (EM). When right turn switch (RT) is ON, break switch (BR) will be overridden.

$$RR = BL(RT + EM \cdot \overline{BR}) + BR \cdot \overline{RT}$$

b)

A_3 LJ/RT	A_2 EM	A_1 BR	A_0 BL	LR/RR
0	0	0	0	0
0	0	0	1	0
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	1
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1

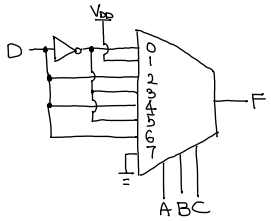


Saturday, 7 March 2020 2:02 am

16) Using Shannon's expansion, ABC as select

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

$= \bar{A}\bar{B}\bar{C}(\bar{D}) + \bar{A}\bar{B}C(\bar{D} + D) + \bar{A}B\bar{C}(D) +$
$\bar{A}BC(\bar{D}) + A\bar{B}\bar{C}(D) + A\bar{B}C(\bar{D}) + AB\bar{C}(D) +$
$ABC(0)$



17) $F = \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}CD + \bar{A}B\bar{C}\bar{D} + A\bar{B}CD +$
$ABC\bar{D} + AB\bar{C}D + ABC\bar{D} + ABCD$

Select AB

$= \bar{A}\bar{B}(\bar{C}D + C(D + \bar{D})) + \bar{A}B(\bar{C}\bar{D}) + A\bar{B}(C\cdot 1) +$
$AB(\bar{C}\bar{D} + \bar{C}D + C\bar{D} + CD)$