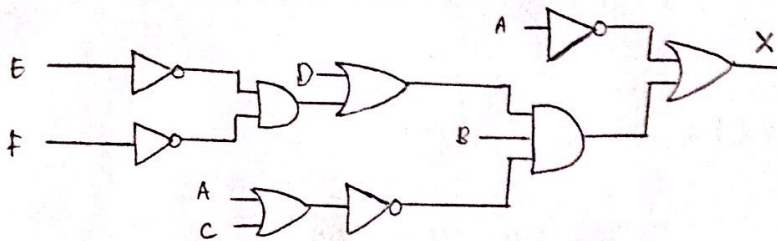
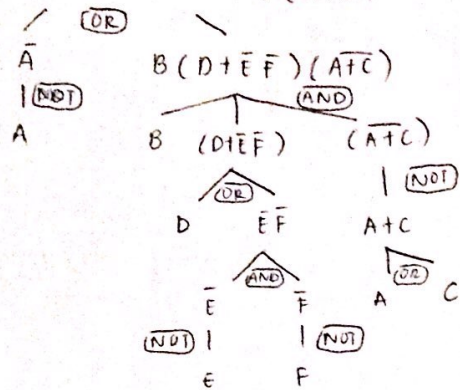


Tutorial 4

1. $X = \bar{A} + B(D + \bar{E}\bar{F})(\bar{A} + C)$



2. i) $Y = \overline{(A + \bar{B} + C)} + \bar{C}\bar{D}\bar{E}$
 $= \bar{A}\bar{B}\bar{C} + \bar{C} + \bar{D} + \bar{E}$
 $= \bar{A}\bar{B}\bar{C} + C + \bar{D} + \bar{E}$

ii) $Y = \overline{P + \bar{Q}(R + SP)}$
 $= \bar{P}\bar{Q} + \bar{R} + \bar{S}\bar{P}$
 $= \bar{P}Q + R + SP$

3. $Y = ABC + A\bar{B} + AB\bar{C} + \bar{A}\bar{B}$
 $= \bar{B}(A + \bar{A}) + AB(\bar{C} + C)$
 $= \bar{B}(1) + AB(1)$
 $= \bar{B} + AB$
 $= B + A$
 $= A + B$

$$4. f = (A + \bar{B})(A + C)(A + B + \bar{C})$$

$$x = 3 \cdot 8$$

$$(A + \bar{B})(A + C)(A + B + \bar{C}) = 111 = 1$$

$$A + \bar{B} = 1 + 0 = 1$$

$$A + \bar{B} = 0 + 1 = 1$$

$$A + \bar{B} = 1 + 1 = 1 \Rightarrow A = 1, 0$$

$$\bar{B} = 0, 1$$

$$A + C = 1 + 0 = 1$$

$$A + C = 0 + 1 = 1$$

$$A + C = 1 + 1 = 1 \Rightarrow A = 1, 0$$

$$A + B + \bar{C} = 1 + 0 + 0 = 1$$

$$A + B + \bar{C} = 1 + 1 + 0 = 1$$

$$A + B + \bar{C} = 1 + 0 + 1 = 1$$

$$A + B + \bar{C} = 0 + 1 + 1 = 1$$

$$A + B + \bar{C} = 1 + 1 + 1 = 1$$

$$A + B + C = 0 + 0 + 0 = 0$$

$$A + B + \bar{C} = 0 + 0 + 1 = 0$$

$$A + \bar{B} + C = 0 + 1 + 0 = 0$$

$$A + \bar{B} + \bar{C} = 0 + 1 + 1 = 0$$

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

→ To standard form

$$f = \underbrace{(A + \bar{B})}_{1st} \underbrace{(A + C)}_{2nd} (A + B + \bar{C})$$

$$1st \text{ term} = A + \bar{B} + C\bar{C}$$

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

$$2nd \text{ term} = A + C + B\bar{B}$$

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

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

A	B	C	$(A + \bar{B})$	$(A + C)$	$(A + B + \bar{C})$	f
0	0	0	1	0	1	0
0	0	1	1	0	0	0
0	1	0	0	1	1	0
0	1	1	0	1	1	0
1	0	0	1	1	1	1
1	0	1	1	1	1	1
1	1	0	1	1	1	1
1	1	1	1	1	1	1

5.

$$f = \bar{A}B(C\bar{D} + CD) + ACD$$

$$= \bar{A}BC\bar{D} + \bar{A}BCD + (ACD + (\bar{B} + \bar{B}))$$

$$= \bar{A}BC\bar{D} + \bar{A}BCD + ABCD + A\bar{B}CD$$

$$0110 \quad 0111 \quad 1111 \quad 1011$$

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

$$\begin{array}{r} 0111 \\ 0110 \\ \hline \bar{A}BC \end{array}$$

$$f = \bar{A}BC + ACD$$

$$\begin{array}{r} 1111 \\ 1011 \\ \hline ACD \end{array}$$

6. i)

A	B	C	f
0	0	1	1
0	1	0	1
1	0	0	1
1	1	1	1

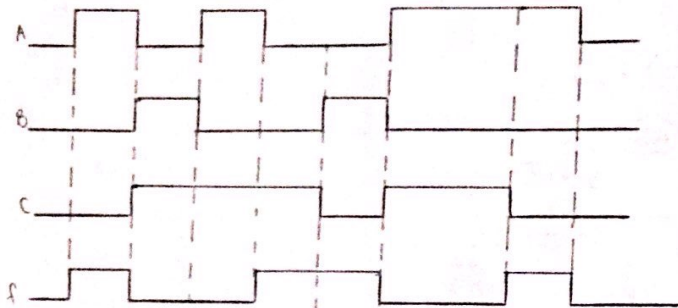
$$f = \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C} + ABC$$

ii)

A	B	C	f
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	0

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

iii)



7. i)

A	B	C	Y
0	0	1	1
0	1	0	1
1	0	0	1
1	1	1	1

$$Y = \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C} + ABC$$

ii)

A	B	C	Y
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	0

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

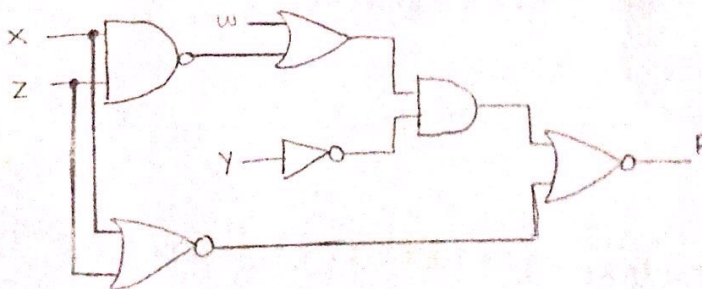
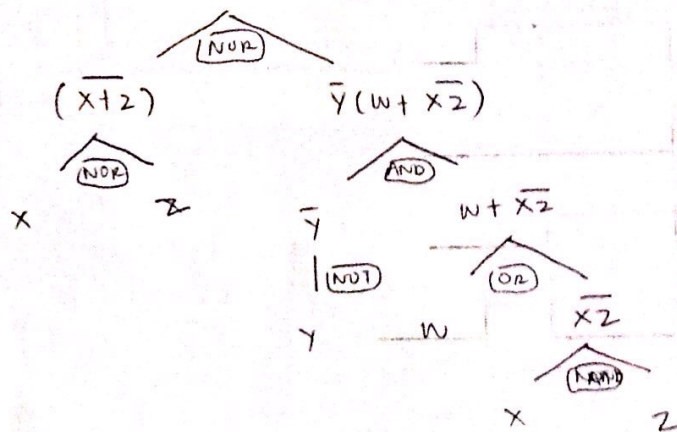
8.

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

A	B	C	Y
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

9.

$$P = \overline{(X+Z)} + \bar{Y}(W+XZ)$$



$$i) Y = \bar{P}\bar{Q}\bar{R}\bar{S} + \bar{P}\bar{Q}R\bar{S} + \bar{P}Q\bar{R}\bar{S} + \bar{P}Q\bar{R}S + P\bar{Q}\bar{R}\bar{S} + P\bar{Q}R\bar{S} + P\bar{Q}R\bar{S}$$

0000 0001 0010 0100 1000 1010 1100

PQ \ RS	00	01	11	10
00	1	1		1
01	1			
11	1			
10	1			1

$$\begin{array}{r} 0000 \\ 0001 \\ \hline \bar{P}\bar{Q}\bar{R} \end{array}$$

$$\begin{array}{r} 0010 \\ 1010 \\ \hline \bar{Q}R\bar{S} \end{array}$$

$$\begin{array}{r} 0000 \\ 0100 \\ 1100 \\ 1000 \\ \hline \bar{R}\bar{S} \end{array}$$

$$Y = \bar{P}\bar{Q}\bar{R} + \bar{Q}R\bar{S} + \bar{R}\bar{S}$$

$$ii) q(w, x, y, z) = \sum m(1, 3, 14, 15) + d(0, 2, 6, 8, 13)$$

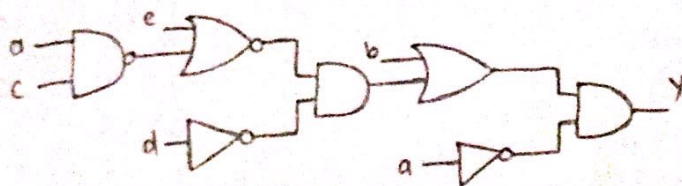
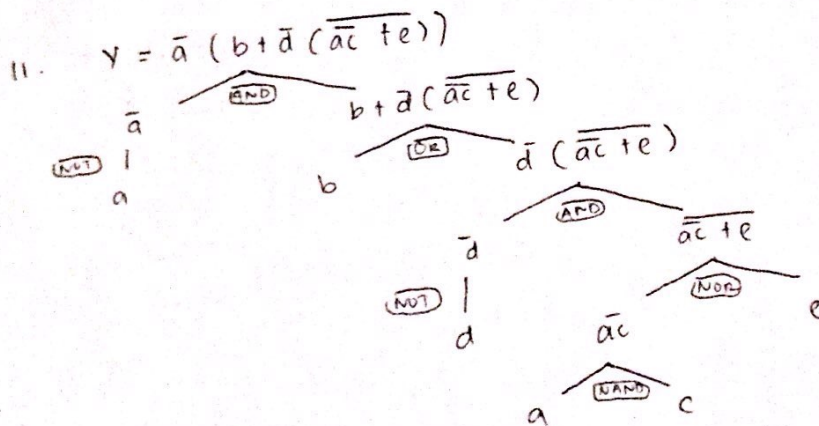
0001 0011 1110 1111 0000 0010 0110 1000 1101

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

$$\begin{array}{r} 0000 \\ 0001 \\ 0011 \\ 0010 \\ \hline \bar{w}\bar{x} \end{array}$$

$$\begin{array}{r} 1111 \\ 1110 \\ \hline wxy \end{array}$$

$$q = \bar{w}\bar{x} + wxy$$



12. $F(p, q, r) = \sum m(0, 1, 3, 4, 6)$

$$F = \bar{p}\bar{q}\bar{r} + \bar{p}\bar{q}r + \bar{p}qr + p\bar{q}\bar{r} + pq\bar{r}$$

000 001 011 100 110

$p \backslash q \backslash r$	0	1
00	1	1
01		1
11	1	
10	1	

$\begin{array}{r} 000 \\ 001 \\ \hline \bar{p}\bar{a} \end{array}$

$\begin{array}{r} 001 \\ 011 \\ \hline \bar{p}r \end{array}$

$\begin{array}{r} 110 \\ 100 \\ \hline p\bar{r} \end{array}$

$$F = \bar{p}\bar{a} + \bar{p}r + p\bar{r}$$

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

from left

$$= x(y + \bar{y}) + \bar{x}\bar{y}$$

$$= x \cdot 1 + \bar{x}\bar{y}$$

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

$$= x + \bar{y} \quad \text{proved}$$