TUTORIAL 3 SOLUTION

Q1)

Q-1. (a) $(17)_{10} \longrightarrow (?)_2$

		Remainder
2	17	
2	8	1 ↑ LSB
2	4	0
2	2	0
	1	0

MSB

Read from the bottom (MSB) to top (LSB) as $(10001)_2$.

$(17)_{10} \longrightarrow (10001)_2$.

(b) $(33)_{10} \longrightarrow (?)_2$

2	33	
2	16	1
2	8	0
2	4	0
2	2	0
	1	0

$\Rightarrow (100001)_2$

(c) $(67)_{10} \longrightarrow (?)_2$

2	67	
2	33	1
2	16	1
2	8	0
2	4	0
2	2	0
	1	0

$\Rightarrow (1000011)_2$

(d) $(130)_{10} \longrightarrow (?)_2$

2	130	
2	65	– 0
2	32	– 1
2	16	– 0
2	8	– 0
2	4	– 0
2	2	– 0
	1	– 0

$\Rightarrow (10000010)_2$

(e) $(2560)_{10} \longrightarrow (?)_2$

2	2560	
2	1280	– 0
2	640	– 0
2	320	– 0
2	160	– 0
2	80	– 0
2	40	– 0
2	20	– 0
2	10	– 0
2	5	– 0
2	2	– 1
	1	– 0

$\Rightarrow (101000000000)_2$

Q2)

Q-2. (a) $(270)_{10}$

first, convert the decimal number into Binary.

2	270	
2	135	– 0
2	67	– 1
2	33	– 1
2	16	– 1
2	8	– 0
2	4	– 0
2	2	– 0
	1	– 0

$\Rightarrow (100001110)_2$

Minimum no. of bits needed to represent $(270)_{10}$ is <u>9 bits</u>.

(b) $(520)_{10}$

2	520	
2	260	– 0
2	130	– 0
2	65	– 0
2	32	– 1
2	16	– 0
2	8	– 0
2	4	– 0
2	2	– 0
	1	– 0

$\Rightarrow (1000001000)_2$

Minimum no. of bits Required $\Rightarrow$ **10 bits**.

(c) $(780)_{10}$

2	780	
2	390	– 0
2	195	– 0
2	97	– 1
2	48	– 1
2	24	– 0
2	12	– 0
2	6	– 0
2	3	– 0
	1	– 1

$\Rightarrow (1100001100)_2$

Min. no. of bits required $\Rightarrow$ **10 bits**.

(d) $(1029)_{10}$

2	1029	
2	514	– 1
2	257	– 0
2	128	– 1
2	64	– 0
2	32	– 0
2	16	– 0
2	8	– 0
2	4	– 0
2	2	– 0
	1	– 0

$\Rightarrow (10000000101)_2$

Min. no. of bits required $\Rightarrow$ **11 bits**.

Q3)

Q-3. (i) $(x_1 + x_3).(\bar{x}_1 + \bar{x}_3) = x_1.\bar{x}_3 + \bar{x}_1.x_3$

LHS : $= (x_1 + x_3)(\bar{x}_1 + \bar{x}_3)$

$= x_1.\bar{x}_1 + x_1.\bar{x}_3 + x_3.\bar{x}_1 + x_3.\bar{x}_3$

{ we know, $A.\bar{A} = 0$ }

$= 0 + x_1.\bar{x}_3 + x_3.\bar{x}_1 + \cancel{x_3} \; 0$

$= x_1.\bar{x}_3 + x_3.\bar{x}_1$

$\Rightarrow$ R.H.S.

(ii) $x_1.\bar{x}_3 + x_1.x_3 + \bar{x}_2.\bar{x}_3 + \bar{x}_2.x_3 = x_1 + \bar{x}_2$

L.H.S : $= x_1.\bar{x}_3 + x_1.x_3 + \bar{x}_2.\bar{x}_3 + \bar{x}_2.x_3$

$= x_1.(\bar{x}_3 + x_3) + \bar{x}_2.(\bar{x}_3 + x_3)$

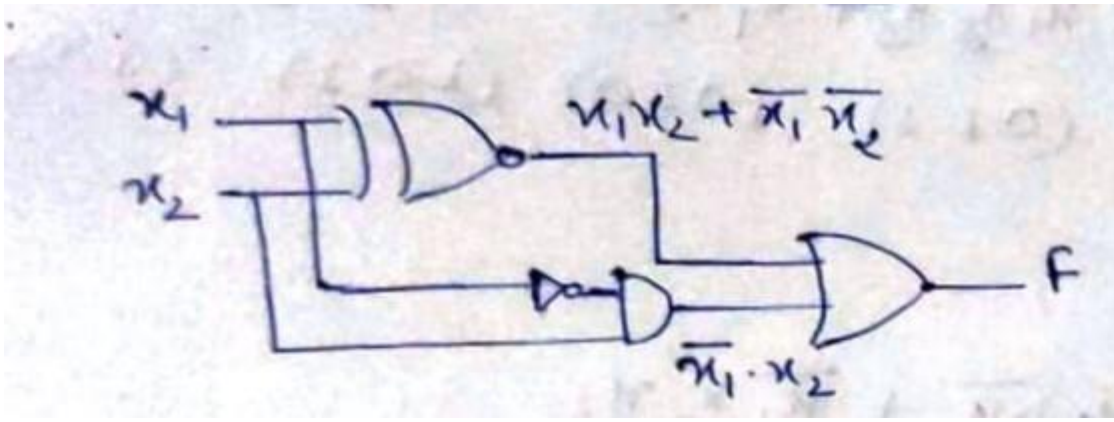
{ we know, $A + \bar{A} = 1$ }

$= x_1.1 + \bar{x}_2.1$

$= x_1 + \bar{x}_2$

$\Rightarrow$ R.H.S.

Q4)
(i)



(ii)

(ii) $f(s_1, s_2, s_3) = \overline{s_1} \cdot \overline{s_2} \cdot s_3 + \overline{s_1} \cdot s_2 \cdot s_3 + s_1 \cdot \overline{s_2} \cdot s_3 + s_1 s_2 \overline{s_3} + s_1 s_2 s_3$

We can write it in SOP:

$F(s_1, s_2, s_3) = \sum(001, 011, 101, 110, 111)$

$= \sum(1, 3, 5, 6, 7)$ [we can minimized it through K-map Also]

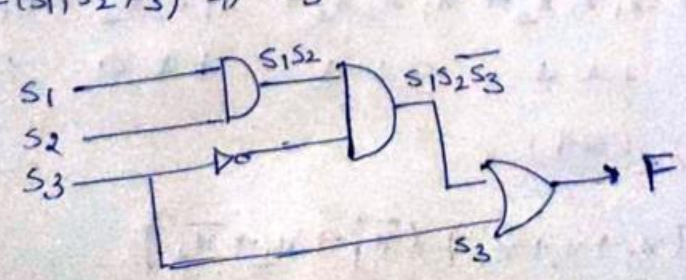
or

$f(s_1, s_2, s_3) = \overline{s_1} \cdot s_3(\overline{s_2} + s_2) + s_1 s_3(\overline{s_2} + s_2) + s_1 s_2 \overline{s_3}$

$= \overline{s_1} \cdot s_3 + s_1 s_3 + s_1 s_2 \overline{s_3}$

$= s_3(\overline{s_1} + s_1) + s_1 s_2 \overline{s_3}$

$f(s_1, s_2, s_3) \Rightarrow s_3 + s_1 s_2 \overline{s_3}$



Q5)

Ans5:

(i) $(x+y)(x+y) = x+y$ ∴ To Prove,

LHS: $(x+y)(x+y) = x\cdot x + x\cdot y + yx + y\cdot y = x + y + xy$

$= x(1+y)+y \Rightarrow x+y$ (therefore LHS = RHS)

(ii) $x\cdot y + y\cdot z + \overline{x}\cdot z = x\cdot y + \overline{x}\cdot z$

LHS: $x\cdot y + y\cdot z + \overline{x}\cdot z =$ we need to remove yz from LHS ∴ we will use $(x+\overline{x}=1)$

$x\cdot y + yz(x+\overline{x}) + \overline{x}\cdot z \Rightarrow x\cdot y + xyz + \overline{x}yz + \overline{x}\cdot z$

$\Rightarrow xy(1+z) + \overline{x}z(1+y)$

$\Rightarrow xy + \overline{x}z$ $\boxed{\text{LHS} = \text{RHS}}$

Proved

Q6)

Q6

(a) $\overline{x_1}x_3 + x_1x_2\overline{x_3} + \overline{x_1}x_2 + x_1\overline{x_2} = \overline{x_2}x_3 + x_1\overline{x_3} + x_2\overline{x_3} + \overline{x_1}x_2x_3$

LHS $\overline{x_1}x_3 + x_1x_2\overline{x_3} + \overline{x_1}x_2 + x_1\overline{x_2}$

$= \overline{x_1}x_3(x_2+\overline{x_2}) + x_1x_2\overline{x_3} + \overline{x_1}x_2(x_3+\overline{x_3}) + x_1\overline{x_2}(x_3+\overline{x_3})$

$= \overline{x_1}x_2x_3 + \overline{x_1}\,\overline{x_2}x_3 + x_1x_2\overline{x_3} + \overline{x_1}x_2x_3 + \overline{x_1}x_2\overline{x_3} + x_1\overline{x_2}x_3 + x_1\overline{x_2}\,\overline{x_3}$

$= (011)\quad(001)\quad(110)\quad(011)\quad(010)\quad(101)\quad(100)$

$= \Sigma m(1,2,3,4,5,6)$

RHS

$(x_1+\overline{x_1})\overline{x_2}x_3 + x_1(x_2+\overline{x_2})\overline{x_3} + (x_1+\overline{x_1})x_2\overline{x_3} + \overline{x_1}x_2x_3$

$= x_1\overline{x_2}x_3 + \overline{x_1}\,\overline{x_2}x_3 + x_1x_2\overline{x_3} + x_1\overline{x_2}\,\overline{x_3} + x_1\overline{x_2x_3} + \overline{x_1}x_2\overline{x_3} + \overline{x_1}x_2x_3$

$= (101)\quad(001)\quad(110)\quad(100)\quad(110)\quad(010)\quad(011)$

$= \Sigma m(1,2,3,4,5,6)$. SOP of RHS = SOP of LHS

$\boxed{\text{∴ Same function}}$.

(b)

(b) $x_1\overline{x_3} + x_2x_3 + \overline{x_2}\,\overline{x_3} = (x_1+\overline{x_2}+x_3)(x_1+x_2+\overline{x_3})(\overline{x_1}+x_2+\overline{x_3})$

LHS:

$x_1\overline{x_3} + x_2x_3 + \overline{x_2}\,\overline{x_3}$

$x_1(x_2+\overline{x_2})\overline{x_3} + (x_1+\overline{x_1})x_2x_3 + (x_1+\overline{x_1})\overline{x_2}\,\overline{x_3}$

$x_1x_2\overline{x_3} + x_1\overline{x_2}\,\overline{x_3} + x_1x_2x_3 + \overline{x_1}x_2x_3 + x_1\overline{x_2}\,\overline{x_3} + \overline{x_1}\,\overline{x_2}\,\overline{x_3}$

LHS $= \Sigma m(110, 100, 111, 011, 100, 000)$

LHS $= \Sigma m(6, 4, 7, 3, 4, 0) \Rightarrow \Pi M(1, 2, 5)$ Ans

RHS $= \Pi M(010, 001, 101)$

RHS $= \Pi M(2, 1, 5)$

$\boxed{\text{RHS} = \text{LHS}}$

(c)

(c) $(x_1+x_3)(\overline{x_1}+\overline{x_2}+\overline{x_3})(\overline{x_1}+x_2)$

LHS:

$\left.\begin{matrix}010\\000\end{matrix}\right\}(x_1+x_3)$

$111 \}\ (\overline{x_1}+\overline{x_2}+\overline{x_3})$

$\left.\begin{matrix}100\\101\end{matrix}\right\}(\overline{x_1}+x_2)$

LHS $= \Pi M(010, 000, 111, 100, 101)$

LHS $= \Pi M(2, 0, 7, 4, 5)$

RHS:

$\left.\begin{matrix}001\\000\end{matrix}\right\}(x_1+x_2)$

$\left.\begin{matrix}000\\100\end{matrix}\right\}(x_2+x_3)$

$\left.\begin{matrix}101\\111\end{matrix}\right\}(\overline{x_1}+\overline{x_3})$

RHS $= \Pi M(000, 001, 100, 101, 111)$

RHS $= \Pi M(0, 1, 4, 5, 7)$

$\boxed{\text{RHS} \neq \text{LHS}}$ Ans

Q7)

sol 7

S_1 = weight

S_2 = small diameter

S_3 = large diameter.

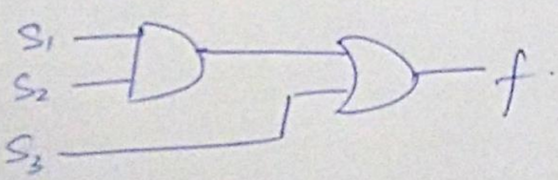
S_1	S_2	S_3	f	
0	0	0	0	m_0
0	0	1	1	m_1
0	1	0	0	m_2
0	1	1	1	m_3
1	0	0	0	m_4
1	0	1	1	m_5
1	1	0	1	m_6
1	1	1	1	m_7

f is 1 if gumball is too large i.e $S_3 = 1$ OR when gumball is small and light i.e $S_1 = 1$ and $S_2 = 1$

therefore from the truth table

$S_1 \backslash S_2S_3$	$\bar{S}_2\bar{S}_3$	$\bar{S}_2S_3$	S_2S_3	$S_2\bar{S}_3$
$\bar{S}_1$		1	1	
S_1		1	1	1

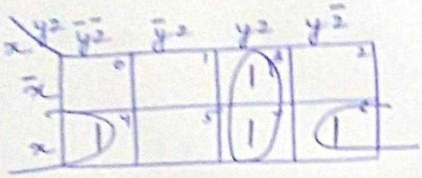
$$f = S_3 + S_1S_2$$



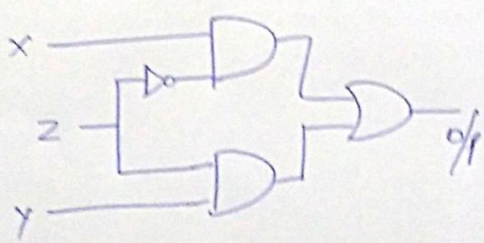
Q8)

Sol 8

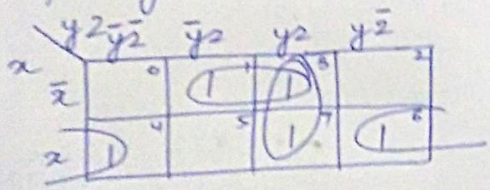
i) $f(x,y,z) = \Sigma m(3,4,6,7)$



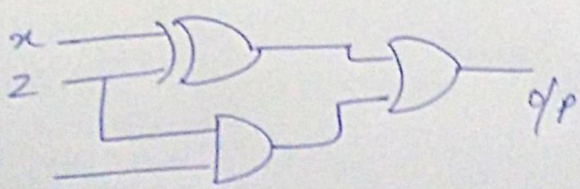
$f(x,y,z) = yz + \bar{z}x$



ii) $f(x,y,z) = \Sigma m(1,3,4,6,7)$



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



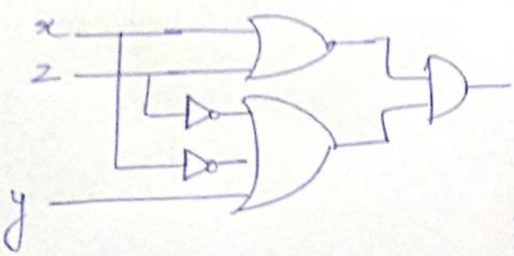
Q9)

Sol?

i) $f(x,y,z) = \Pi M(0,2,5)$

$x \backslash yz$	$y+z$	$y+\bar{z}$	$\bar{y}+\bar{z}$	$\bar{y}+z$
x	0			0
$\bar{x}$		0		

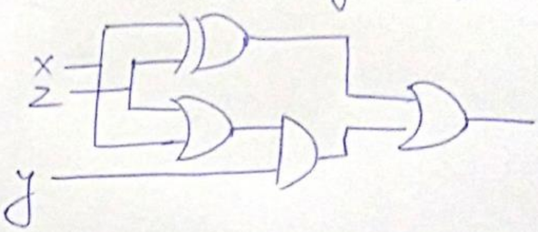
$f(x,y,z) = (x+z)(\bar{x}+y+\bar{z})$



OR

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

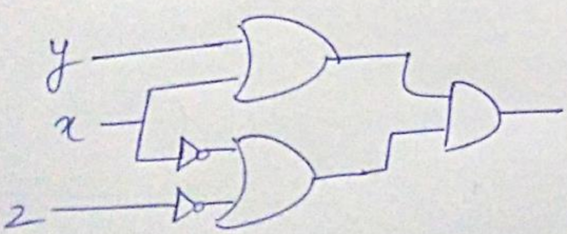
$= x \oplus z + y(x+z)$



ii) $f(x,y,z) = \Pi M(0,1,5,7)$

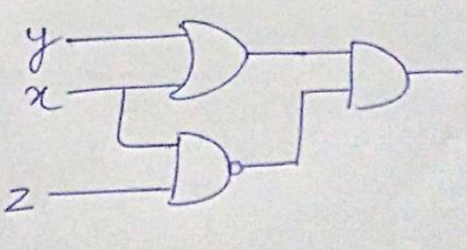
$x \backslash yz$	$y+z$	$y+\bar{z}$	$\bar{y}+\bar{z}$	$\bar{y}+z$
x	0	0		
$\bar{x}$		0	0	

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



OR

$= (\overline{xz})(x+y)$



Q10)

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

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

$= w.\bar{y} + x.\bar{y}.z$

Q11)

11) $f(w,x,y,z) = (w+y+z).(x+y+z).(w+x+y)$

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

The expression can't be simplified further

It contains 3 terms

Q12)

12)

x_1	x_2	x_3	F
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

$\Rightarrow$

$x_1 \backslash x_2x_3$	$\bar{x}_2\bar{x}_3$	$\bar{x}_2x_3$	x_2x_3	$x_2\bar{x}_3$
$\bar{x}_1$	0	0	1	0
x_1	0	1	1	1

$$\Rightarrow F(x_1 x_2 x_3) = x_1 \cdot x_3 + x_1 \cdot x_2 + x_2 \cdot x_3$$