Tutorial 4 Solution

Q1)

Q1) $F = \sum 1, 2, 5, 4, 7, 10, 12, 15$

$SOP = B\bar{C}\bar{D} + \bar{A}\bar{C}D + BCD + \bar{B}C\bar{D}$

$AB \backslash CD$	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	0	1 1	3	1 2
$\bar{A}B$	1 4	1 5	1 7	6
AB	1 12	13	1 15	14
$A\bar{B}$	8	9	11	1 10

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

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

Q2)

* (a) $(523)_8$

Here base is 8.
Hence 7's complement can be calculated by subtracting each bit by 7.

$$(777-523)_8 = (254)_8$$

(b) $(467)_{10}$

Here base is 10.
Hence 9's complement can be calculated by subtracting each bit by 9.

$$(999-467)_{10} = (532)_{10}$$

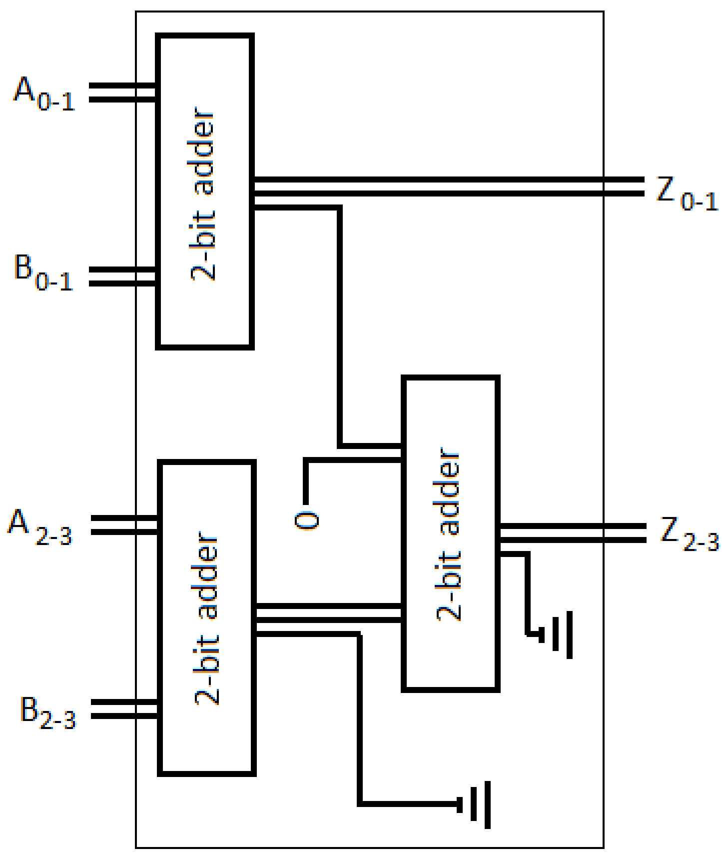
(c) $(10110)_2$

1's complement is $(01001)_2$

Q3)

X	Y	Z	A	B
0	1	0	0	1
1	1	1	0	0
0	0	1	0	1
1	0	1	1	1
0	1	1	1	0

Q4)



Q5)

(a) $z(a,b,c) = a + \bar{b}c$ (from the circuit)

1. Converting 'z' in canonical SOP form.

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

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

$$z = \underset{m_7}{abc} + \underset{m_6}{ab\bar{c}} + \underset{m_5}{a\bar{b}c} + \underset{m_4}{a\bar{b}\bar{c}} + \underset{m_5}{a\bar{b}c} + \underset{m_1}{\bar{a}\bar{b}c}$$

$$\{a + \bar{a} = 1\}$$

a	b	c	minterms	
0	0	0	$\bar{a}\bar{b}\bar{c}$	m_0
0	0	1	$\bar{a}\bar{b}c$	m_1
0	1	0	$\bar{a}b\bar{c}$	m_2
0	1	1	$\bar{a}bc$	m_3
1	0	0	$a\bar{b}\bar{c}$	m_4
1	0	1	$a\bar{b}c$	m_5
1	1	0	$ab\bar{c}$	m_6
1	1	1	abc	m_7

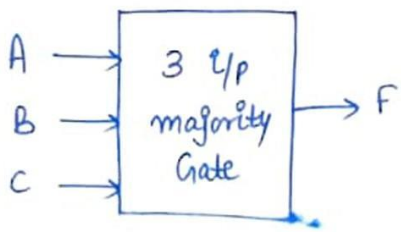
So, $\boxed{z(a,b,c) = \sum(1,4,5,6,7)}$

↳ SOP form (canonical)

$\boxed{z(a,b,c) = \prod(0,2,3)}$

↳ POS form (canonical)

(b)



The output is logic high when 1's are in majority at the input else output is logic low.

Truth-Table

	A	B	C	F
	0	0	0	0
	0	0	1	0
	0	1	0	0
m_3	0	1	1	1
	1	0	0	0
m_5	1	0	1	1
m_6	1	1	0	1
m_7	1	1	1	1

$$F = \sum m(3, 5, 6, 7)$$

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

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

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

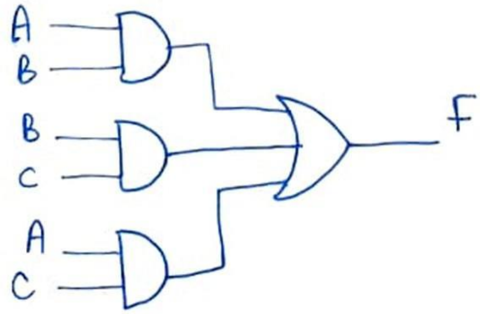
$$= B(C + A\bar{C}) + A\bar{B}C$$

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

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

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

$$\boxed{F = AB + BC + AC} \Rightarrow \text{Minimized form}$$



Q6)

$$f_1(A,B,C) = \sum(2,3,4)$$

$$f_2(A,B,C) = \pi(0,1,3,6,7)$$

$$= \sum(2,4,5)$$

(Converting to Standard SOP form)

$$f_1 \cdot f_2 = \sum m(2,4)$$

Now, for function f to be zero,

$$f_3(A,B,C) = \overline{[f_1(A,B,C) \cap f_2(A,B,C)]}$$

$$= \sum(0,1,3,5,6,7)$$

$\therefore$, maximum minterms possible are 6.

Q7)

Given: 4-bits 2's Complement Numbers

(i) 1011 (in 2's complement)

$\downarrow -1$

1010 (1's complement)

$\downarrow$ Replace $(0 \leftrightarrow 1)$

0101 (i.e +5)

(ii) 0110 (in 2's complement)

$\downarrow -1$

0101 (1's complement)

$\downarrow$ Replace $(0 \leftrightarrow 1)$

1010 (i.e +10)

Result = $10+5 \Rightarrow 15 \Rightarrow (1111)_2$

$\downarrow$ Replace $(0 \leftrightarrow 1)$

0000 (in 1's complement)

$\downarrow +1$

Ans $\boxed{0001}$ (2's complement).

Q8)

$(45)_{10} - (45)_{16}$

for substraction, they must be in same radix

$(45)_{16} = 5\times 16^0 + 4\times 16^1 = 5+64 = (69)_{10}$

Result $= (45)_{10} - (69)_{10} = (-24)_{10}$

$(24)_{10} \rightarrow (011000)_2$

$\downarrow$ Replace ($0 \leftrightarrow 1$)

(100111) (in 1st complement)

$\downarrow +1$

Ans $\boxed{101000}$ 2's complement $\Rightarrow (-24)_{10}$