BRAC University

Assignment-02

Subject title: Digital Logic and Design
Subject code:CSE260
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Section:08
Submission Date: 30.10.2022

Date : / /

Ans to the question - 1

a) Given that.

$f(w,x,y,z) = ((w'x+y'z)(x+yz)')$

$= (w'x+y'z)' + (x+yz)''$

$= (w'x+y'z)' + x + yz$

$= (w'x)' \cdot (y'z)' + x + yz$

$= (w''+x')(y''+z') + x + yz$

$= (w+x')(y+z') + x + yz$

$= (y+z')w + (y+z')x + x + yz$

$= (y+z')w + y + z' + x + yz$

$= (y+z')w + y + yz + z' + x$

$= (y+z')w + y(1+z) + z' + x$

$= (y+z')w + y + z' + x$

$= wy + wz' + y + z' + x$

$= wy + y + wz' + z' + x$

$= y(w+1) + wz' + z' + x$

$= y + z'(w+1) + x$

$= x$

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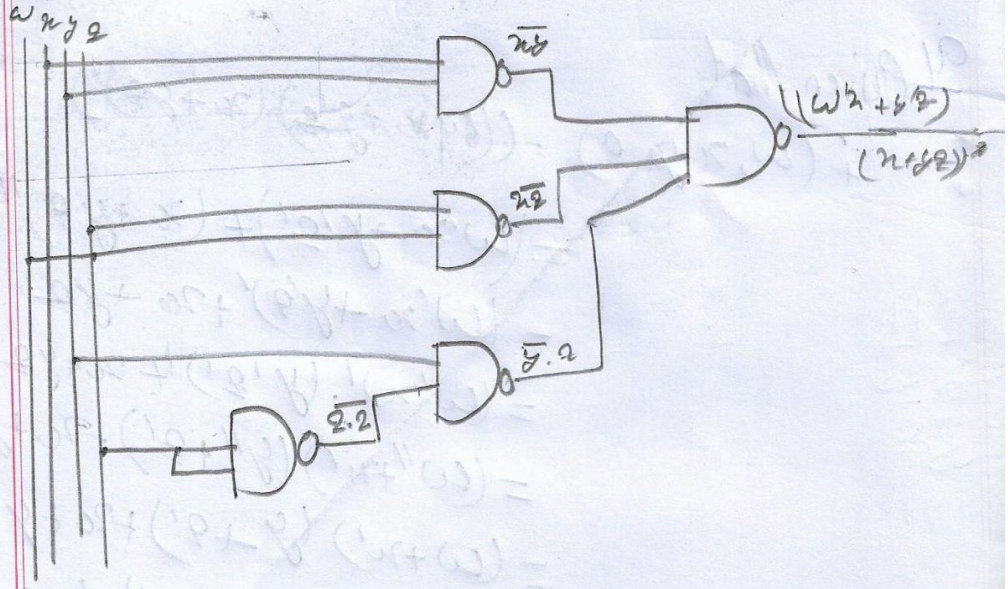
$= y + z' + x$

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



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01 Given that

$F(w,x,y,z) = \Sigma(0,1,2,3,9,11)$

$= \Sigma(0000, 0001, 0010, 0011, 1001, 1011)$

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

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

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

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

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

$= \bar{w}\bar{x}\cdot 1 + w\bar{x}z$

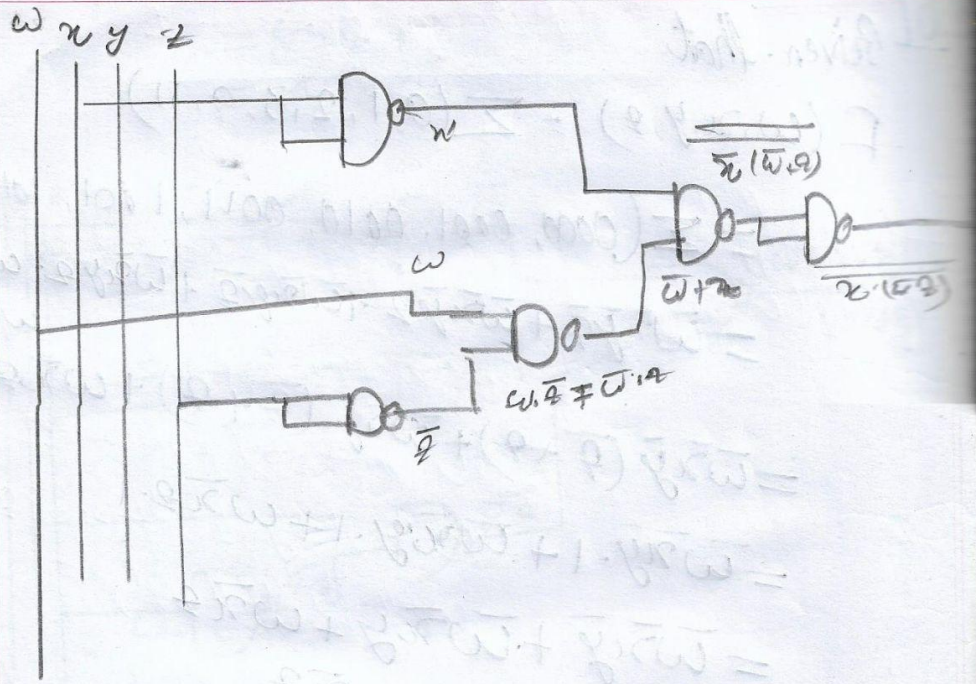
$= \bar{w}\bar{x} + w\bar{x}z$

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

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

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

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


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

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c) Given that:

$f(a,b,c) = M(0,5,7)$

$= M_0 + M_5 + M_7$

000 101 111

$= (a+b+c).(a'+b+c').(a'+b'+c')$

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

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

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

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

$= (a+b+c)(\bar{a} + \bar{a}.1 + \bar{a}.\bar{c} + \bar{c}(b+\bar{b}))$

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

$= (a+b+c)(\bar{a} + \bar{c}(1+\bar{a}) + \bar{c})$

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$$= (a+b+c)(\bar{a}+\bar{c}\cdot 1+\bar{c})$$

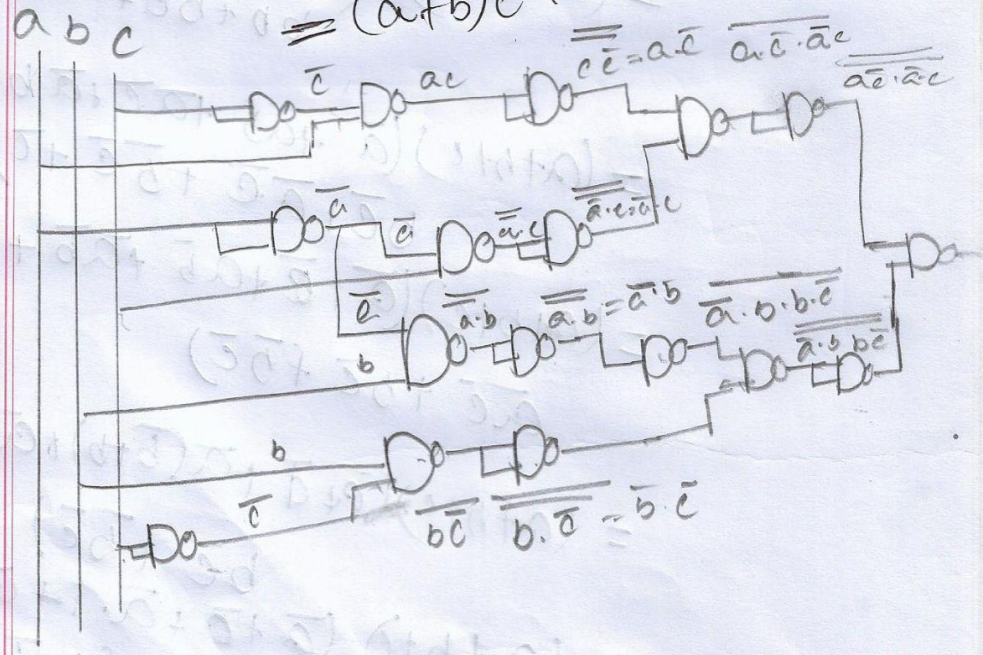
$$= (a+b+c)(\bar{a}+\bar{c})$$

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

$$= (0+a\bar{c}+\bar{a}b+b\bar{c}+\bar{a}c+0)$$

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

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



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Ans to the question on 2

a) Given that,

$f(a,b,c,d) = \sum(0,2,4,6,12,14)$

$= \sum(0000, 0010, 0100, 0110, 1100, 1110)$

$= a'b'c'd' + a'bcd' + ab\acute{e}d' + a\acute{b}cd' + a\acute{b}e\acute{d}' +$ abcd'

$= a'bd'(c'+c) + abd'(c'+c) + abd'(c'+c)$

$= a'bd' + abd' + abd'$

$= a'd' + abd'$

$= d'(a' + ab)$

$= d'(a'+b)$

$= a'd' + bd'$

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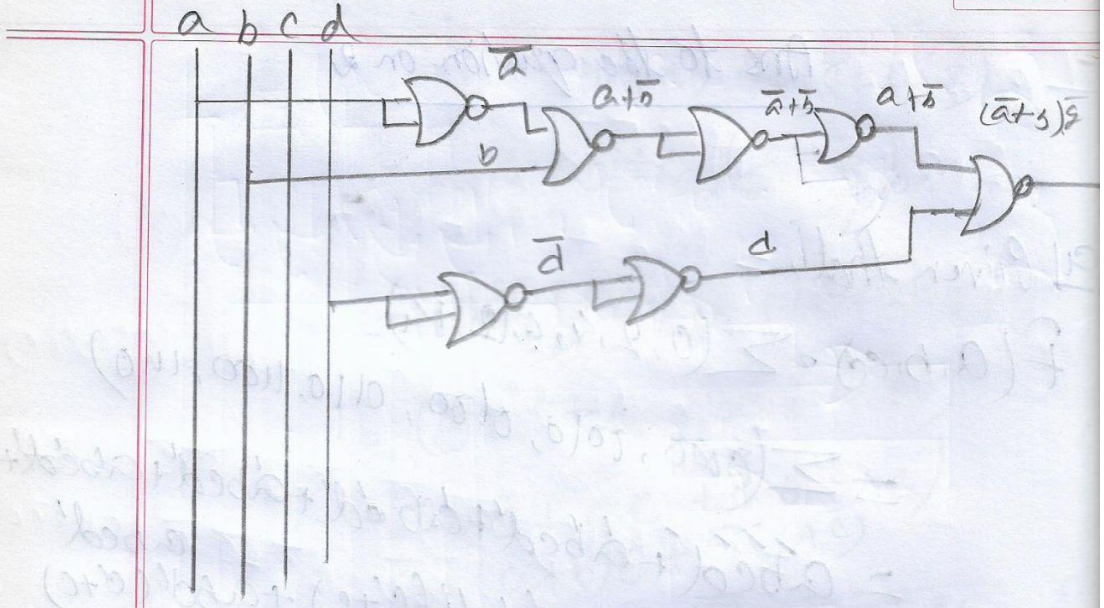

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5) Given that,

$F(a,b,c,d) = (a+b')(a'+bc+d')(d+c')$

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

$= (a+\bar{b})(\bar{a}d + \bar{a}\bar{c} + bcd + b\cdot c\bar{c} + a\bar{a} + \bar{c}d)$

$= a+\bar{b}(\bar{a}d + \bar{a}\bar{c} + bcd + b\cdot 0 + 0 + \bar{c}d)$

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

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

$= a\cdot\bar{a}\cdot d + a\bar{a}\cdot\bar{c} + abcd + a\bar{c}\bar{d} + \bar{a}\bar{b}d + \bar{a}\bar{b}\bar{c} + b\bar{b}\cdot cd + \bar{b}\bar{c}\bar{d}$

$= 0 + 0 + abcd + a\bar{c}\bar{d} + \bar{a}\bar{b}d + \bar{a}\bar{b}\bar{c} + 0 + \bar{b}\bar{c}\bar{d}$

$= abcd + a\bar{c}\bar{d} + \bar{a}\bar{b}d + \bar{a}\bar{b}\bar{c} + \bar{b}\bar{c}\bar{d}$

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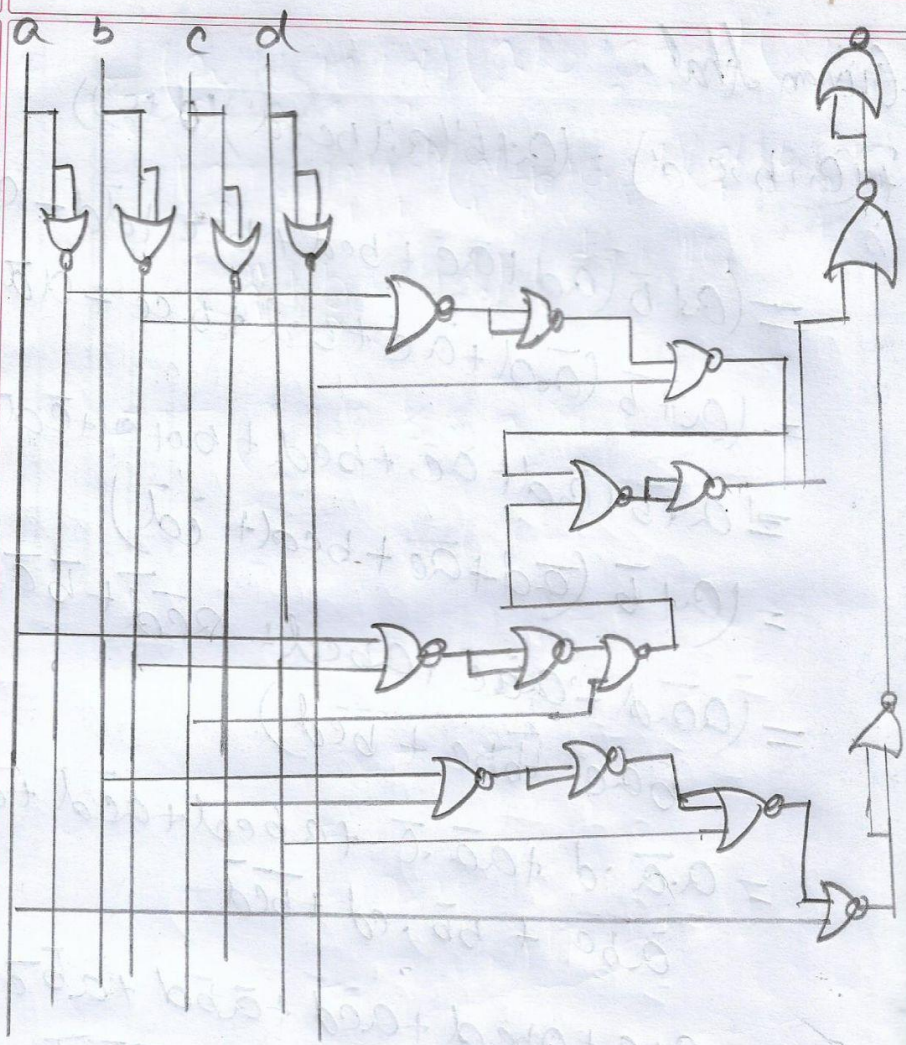

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c) Given that:

$f(a,b,c) = M(0,5,7)$

$= M_0 + M_5 + M_7$

000 101 111

$= (a+b+c).(a'+b+c').(a'+b'+$

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

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

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

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

$= (a+b+c)(\bar{a} + \bar{a} + \bar{a}.1 + \bar{a}.\bar{c} +$
$\bar{c}(b+\bar{b})$

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

$= (a+b+c)(\bar{a} + \bar{c}(1+\bar{a}) + \bar{c})$

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$= (a+b+c)(\bar{a}+\bar{c}+1+\bar{c})$

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

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

$= (0+a\bar{c}+\bar{a}b+b\bar{c}+\bar{a}c+0)$

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

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

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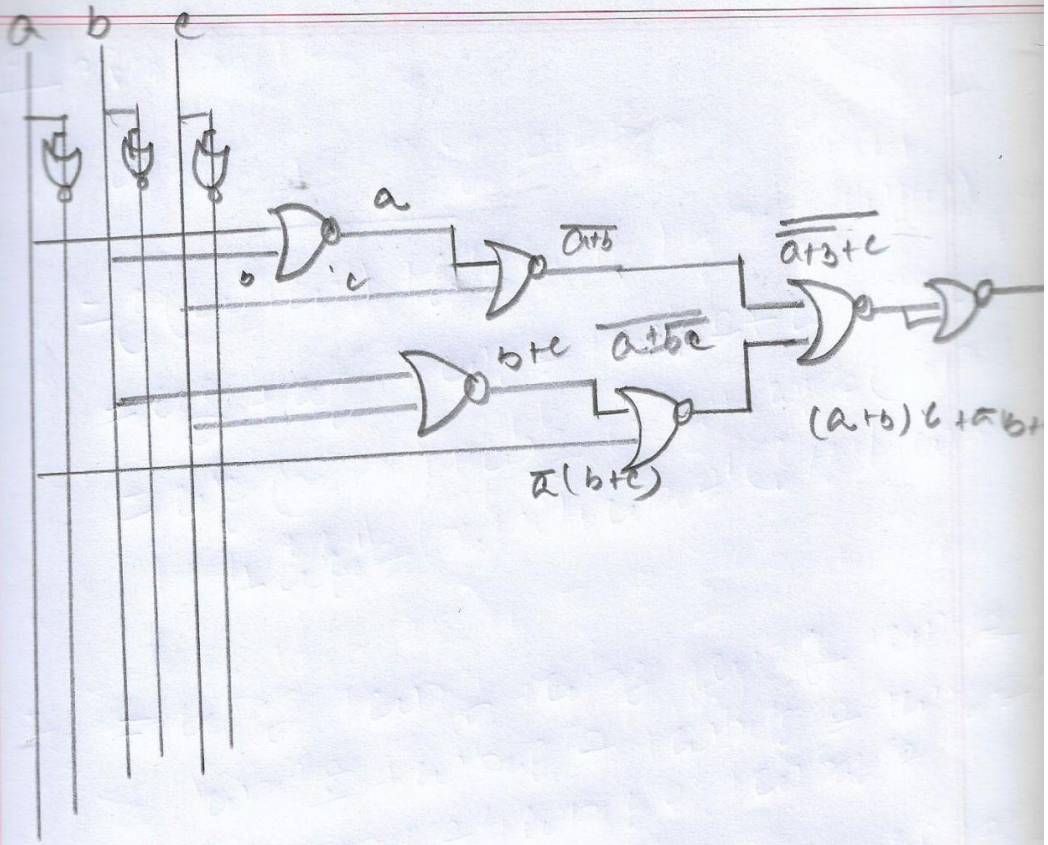
c


a b c
a
b c
$\overline{a+b}$
$\overline{\overline{a+b}+c}$
b+c
$\overline{a+bc}$
$\overline{a}(b+c)$
(a+b)c+$\overline{a}$b+

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Ans to the questions

a) Given that,

$$f(a,b,c,d) = a'b + b(a+c)$$

$$= b(a'+a+c)$$

$$= b(1+c)$$

$$= b \cdot 1$$

$$= b$$

$$= b + a \cdot a'$$

$$= (a+b)(a'+b)$$

$$= (a+b+c \cdot c')(a'+b+cc')$$

$$= (a+b+c)(a+b+c')(a'+b+c)(a'+b+c')$$

$$= (a+b+c+dd')(a+b+c'+dd')(a'+b+c+dd')(a'+b+c'+dd')$$

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$= (a_0 + b_0 + c_0 + d_0)(a_0 + b_0 + c_0 + d_1)(a_0 + b_0 + c_0 + d_0)$

$(a_0 + b_0 + c_1 + d_1)(a_1 + b_0 + c_0 + d_1)(a_1 + b_0 + c_0 + d_0)$

$(a_1 + b_0 + c_1 + d_0)(a_1 + b_0 + c_1 + d_1)$

$= \pi\{0, 1, 2, 3, 8, 9, 10, 11\}$

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b) Given that,

$f(a,b,c) = a' + ab(b'+c')$

$= a' + abb' + abc'$

$= a' + a + abc'$

$= a' + abc'$

$= (a'+a)(a'+bc')$

$= (a'+bc')$

$= a' + bc'$

$= (a'+b)(a'+c')$

$= (a'+b+cc')(a'+c'+bb')$

$= (a'+b+c)(a'+b+c')$

$(a'+b+c')(a'+b'+c')$

$= (a'+b+c)(a'+b+c')$
$(1\ 0\ 0)\quad(1\ 0\ 1)$

$(a'+b'+c')$
$(1\ 1\ 1)$

$= \Pi(4,5,7)$

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Q1

Given that,

$F(w,x,y,z) = xy + y'(z+xz')$

$= xy + y'(z+x)(z+z')$

$= xy + y'(z+x)$

$= xy + y'z + xy'$

$= xy + xy' + y'z$

$= x(y+y') + y'z$

$= x \cdot 1 + y'z$

$= x + y'z$

$= (x+y')(x+z)$

$= (x+y'+zz')(x+z+yy')$

$= (x+y'+z)(x+y'+z')(x+y+z)$
$(x+y'+z)$

$= x+y'+z+ww')(x+y'+z'+ww')$
$(x+y+z+ww')(x+y'+z+ww')$

$(w+x+y'+z)(w+x+y'+z)(w+x+y'+z')$

$= (w+x+y'+z)(w+x+y'+z)(w+x+y+z)(w'+x+y+z)$
$(w'+x+y'+z')(w+x+y+z)$
$(w+x+y'+z)(w'+x+y'+z')$

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$= (w+x+y+z)(w+x+y+z)(w+x+y+z)$

$= \pi(0, 2, 3, 8, 10, 11)$

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Ans to the question no 4

(a) Given that,

$$f(w,x,y,z) = yz' + z(y+x')$$

$$= yz' + zy + zx$$

$$= yz'(w+w') + zy(w+w') + zx(w+w')$$

$$= wyz' + w'yz' + wyz + w'yz + xwz + xw'z$$

$$= wyz'(x+x') + w'yz'(x+x') + wyz(x+x') + w'yz(x+x') + xwz(y+y') + xw'z(y+y')$$

$$= wxyz' + wx'yz' + wxyz + wx'yz + wxyz + wxy'z + wxyz + wxy'z + wxyz + w'xyz + wxyz + w'xy'z$$

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$= \omega x y z' + \omega x y z + \omega' x y z' + \omega x y z +$
$\omega x y z + \omega' x y z + \omega' x y z + \omega x y' z' + \omega' x y' z +$
$\omega' x' y z' + \omega x' y' z + \omega' x' y' z'$

$= \sum (14, 10, 6, 15, 11, 7, 3, 13, 9, 1, 2)$

$= \sum (1, 2, 3, 6, 7, 9, 10, 11, 14, 15)$

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b) Given that,

$F(a,b,c) = b + c'(a' + b'c)$

$= b + ca' + cb'c$

$= b + ca' + c'c \cdot b'$

$= b + ac' + 0$

$= b + ac'$

$= b(a + a') + ac'(b + b')$

$= ab + ab' + a'bc' + ab'c'$

$= ab(c + c') + ab(c + c') + abc + a'bc'$

$= abc + abc' + abc + abc' + abc + a'bc' + a'bc'$

$= \underset{111}{abc} + \underset{110}{abc'} + \underset{011}{abc} + \underset{010}{abc'} + \underset{000}{a'b'c'}$

$= \Sigma(7, 6, 3, 2, 0)$

$= \Sigma(0, 2, 3, 6, 7)$

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c) given that

$f(w,x,y,z) = y + yz + zz'$

$= y(w+w') + yz(w+w') + zz'(w+w')$

$= wy + w'y + wyz + w'yz + wxz' + w'x$

$= wy(x+x') + w'y(x+x') + wyz(x+x')$

$+ w'yz(x+x') + wxz'(y+y') + wx$

$= wxy + wx'y + w'xy + w'x'y + wxyz$

$wx'yz + w'xyz + w'x'yz + wxyz'$

$= wxy(z+z') + wx'y(z+z') + w'xy(z+z')$

$w'x'y(z+z') + wxyz + wx'yz + w'xyz$

$wx'yz + wxyz' + w'xyz' +$

$w'x'yz'$

$= wxyz + wxyz' + wxy'z + wxy'z' + wx'yz + wx'yz' + wx'y'z + wx'y'z' + w'xyz + w'xyz' + w'xy'z + w'xy'z' + w'x'yz + w'x'yz' + w'x'y'z + w'x'y'z'$

$= \sum (1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15)$