ASSIGNMENT # 1

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QNO1:-

1:- Convert following into binary number: 0, 1, 13, 15.

Solution:-

$(0)_{10}$

$(0)_{10} = (0)_2$

$(1)_{10} = (01)_2$

$(13)_{10} = (1101)_2$

$(15)_{10} = (1111)_2$

2	13	2	15
2	6 − 1	2	7 − 1
2	3 − 0	2	3 − 1
	1 − 1		1 − 1

QNO2:-

2:- Convert the following hexadecimal numbers in binary, decimal, and octal;

$(A100)_{16}$

Sol:-

$(A100)_{16}$ $\because A = 10$ and $(10)_{16} = 1010$

$(A100)_{16} = (1010\ 0001\ 0000\ 0000)_2$

→ Hexadecimal to decimal

$(A100)_{16} = (1010\ 0001\ 0000\ 0000)_2$

1010 0001 0000 0000

$= 2^{15} + 2^{14} + 2^{13} + 2^{12} + 2^{11} + 2^{10} + 2^{9} + 2^{8}\ 2^{7} + 2^{6} + 2^{5} + 2^{4} + 2^{3} + 2^{2} + 2^{1} + 2^{0}$

$= 32768 + 8192 + 256$

$(A100)_{16} = (41216)_{10}$

Alternate method:

$(A100)_{16} = (41216)_{10}$

$(10100)_{16} = 16^3 \times 10 + 16^2 \times 1 + 16^1 \times 0 + 16^0 \times 0$

$(10100)_{16} = 40960 + 256 + 0 + 0$

$(10100)_{16} = (41216)_{10}$

$(A100)_{16} = (41216)_{10}$

→ Hexadecimal to octadecimal :-

$(A100)_{16} = (120400)_8$

= 001 010 000 100 000 000

1 2 0 4 0 0

$(A100)_{16} = (120400)_8$

$(FF)_{16} = (1111\ 1111)_2$

$(FF)_{16} = (255)_{10}$

1 1 1 1 1 1 1 1

$2^7 + 2^6 + 2^5 + 2^4 + 2^3 + 2^2 + 2^1 + 2^0$

$= 128 + 64 + 32 + 16 + 8 + 4 + 2 + 1$

$= 255$

$(FF)_{16} = (377)_8$

011 111 111

3 7 7

→ $(0F9)_{16} = (000011111001)_2$

$(0F9)_{16} = (249)_{10}$

0 0 0 0 1 1 1 1 1 0 0 1

$2^7 + 2^6 + 2^5 + 2^4 + 2^3 + 2^0$

$= 128 + 64 + 32 + 16 + 8 + 1$

$= 249$

$(0F9)_{16} = (371)_8$

011 111 001

3 7 1

→ $(A10F)_{16}$

$(A10F)_{16} = (1010\ 0001\ 0000\ 1111)_2$

$(A10F)_{16} = (41231)_{10}$

1 0 1 0 0 0 0 1 0 0 0 0 1 1 1 1

$2^{15} + 2^{14} + 2^{13} + 2^{12}\ 2^{11}\ 2^{10}\ 2^9\ 2^8\ 2^7\ 2^6\ 2^5\ 2^4\ 2^3 + 2^2 + 2^1 + 2^0$

$= 32768 + 8192 + 256 + 8 + 4 + 2 + 1$

$= 41231$

$(A10F)_{16} = (120417)_8$

= 001 010 000 100 001 111

= 1 2 0 4 1 7

$= (120417)_8$

QNO3:-

Convert the following decimal number into binary and then octal.

→ $(5432)_{10}$

Solution:-

$(5432)_{10} = (1010100111000)_2$

2	5432
2	2716 - 0
2	679 - 0
2	339 - 1
2	169 - 1
2	84 - 1
2	42 - 0
2	21 - 0
2	10 - 1
2	5 - 0
2	2 - 1
	1 - 0

$(5432)_{10} = (12470)_8$

001 010 100 111 000

1 2 4 7 0

= 12470

→ $(79)_{10}$

$(79)_{10} = (1001111)_2$

2	79
2	39 - 1
2	19 - 1
2	9 - 1
2	4 - 1
2	2 - 0
	1 - 0

$(79)_{10} = (117)_8$

(001 001 111)

1 1 7

$= (117)_8$

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QNO 4:-

What is the largest number that can be represented with 5-bits, 10-bits, 22-bits?

Sol:-

5-bits:-

5 bit = 11111

$2^4 + 2^3 + 2^2 + 2^1 + 2^0 \Rightarrow 16+8+4+2+1 \Rightarrow 31$

$2^5 - 1 = 31$

10 bits:-

1111111111

$2^9 + 2^8 + 2^7 + 2^6 + 2^5 + 2^4 + 2^3 + 2^2 + 2^1 + 2^0$

$= 512 + 256 + 128 + 64 + 32 + 16 + 8 + 4 + 2 + 1$

$= 1023$

22-bits:-

1111111111111111111111

$2^{15} + 2^{14} + 2^{13} + 2^{12} + 2^{11} + 2^{10} + 2^9 + 2^8 + 2^7 + 2^6 + 2^5 + 2^4 + 2^3 + 2^2 + 2^1 + 2^0$
$2^{21} + 2^{20} + 2^{19} + 2^{18} + 2^{17} + 2^{16}$

$= 4194304.$

QNO 5:-

Work exercise 1.2:-

What is the exact number of bytes in a system that contains (a) 32K bytes (b) 64M bytes, and (c) 6.4G bytes?

(a) 32K bytes:

$= 32 \times 1024$ bytes

$= 32,768$ bytes.

(b): 64M bytes:

$= 64 \times 1024 \times 1024$

$= 67108864$ bytes.

(c) 6.4 G bytes:

$= 6.4 \times 1024 \times 1024 \times 1024$

$= 6871947674$ bytes.

Exercise:

1.7 Convert the hexadecimal number 64CD to binary, and then convert it from binary to octal.

Sol:-

$(64CD)_{16}$

$(64CD)_{16} = (0110\ 0100\ 1100\ 1101)_2$

$(64CD)_{16} =$ 110 010 011 001 101

6 2 3 1 5

$(64CD)_{16} = (62315)_8$

$(0110010011001101)_2 = (62315)_8$

4

Exercise 1.8

$(431)_{10}$ into binary

First method: Division method.

$(431)_{10} = (110101111)_2$

2	431
2	215 − 1
2	107 − 1
2	53 − 1
2	26 − 1
2	13 − 0
2	6 − 1
2	3 − 0
	1 − 1

Decimal to hexadecimal

$(431)_{10} = (\underbrace{0001}_{1}\ \underbrace{1010}_{A}\ \underbrace{1111}_{F})_2$

$(431)_{10} = (1AF)_{16}$

16	431
16	26 − 15
	1 − 10

Hexadecimal to binary

$(1AF)_{16}$

= 1 A F

= 0001 1010 1111

= 000110101111

$(1AF)_{16} = (000110101111)_2$

The conversion of Decimal to hexadecimal and then into binary is faster method.

Exercise 1.9 :

Express the following number in decimal :

(a) $(10110.0101)_2$.

Sol:-

$(10110.0101)_2 = (22.3125)_{10}$

$= 2^4 \; 2^3 \; 2^2 \; 2^1 \; 2^0 \; 2^{-1} \; 2^{-2} \; 2^{-3} \; 2^{-4}$

$= 1 \; 0 \; 1 \; 1 \; 0 \; 0 \; 1 \; 0 \; 1$

$= [16 + 4 + 2] \cdot [0.25) + 0.0625] \Rightarrow 22 + 3.125$

$= (22.3125)_{10}$

(b) $(16.5)_{16}$.

Sol:-

$= (16.5)_{16}$

$= 1 \quad 6 \quad .5$

$= 0001 \quad 0110. \, 0101$

$(16.5)_{16} = (00010110.0101)_2$

$= 2^4 \; 2^3 \; 2^2 \; 2^1 \; 2^0 . 2^{-1} \; 2^{-2} \; 2^{-3} \; 2^{-4}$

$1 \; 0 \; 1 \; 1 \; 0 . 0 \; 1 \; 0 \; 1$

$= (16 + 4 + 2) + (0.25 + 0.0625)$

$= 22 + 0.3125$

$= (22.3125)_{10}$

$(16.5)_{16} = (22.3125)_{10}$

(C) $(26.24)_8$

Sol:-

$(26.24)_8 = (22.3125)_{10}$

2 6 . 2 4

010 110 . 010 100

$(26.24)_8 = (010110.010100)_2$

$= 2^5\ 2^4\ 2^3\ 2^2\ 2^1\ 2^0\ 2^{-1}\ 2^{-2}\ 2^{-3}\ 2^{-4}\ 2^{-5}\ 2^{-6}$

$= 0\ 1\ 0\ 1\ 1\ 0\ .\ 0\ 1\ 0\ 1\ 0\ 0$

$= (16+4+2) + (0.25 + 0.0625)$

$= (22) + (0.3125)$

$= (22.3125)_{10}$

(D) $(DADA.B)_{16}$

-:(Solution):-

$(DADA.B)_{16} = (56026.6875)_{10}$

D	A	D	A	B
1101	1010	1101	1010	1011
$2^{15}2^{14}2^{13}2^{12}$	$2^{11}2^{10}2^{9}2^{8}$	$2^{7}2^{6}2^{5}2^{4}$	$2^{3}2^{2}2^{1}2^{0}$	$2^{-1}2^{-2}2^{-3}2^{-4}$

$= (32768+16384+4096+2048+512+128+\overset{+16+8}{64}) + (0.5+0.125+0.0625)$

$= (56026.6875)_{10}$

Alternate method.

$(DADA.B)_{16} = (13\times16^3)+(10\times16^2)+(13\times16^1)+(10\times16^0)+(11\times16^{-1})$

$= (56026.6875)_{10}$

(e) $(1010.1101)_2$

Solution:

$(1010.1101)_2 = (10.8125)_{10}$

$= 1 \quad 0 \quad 1 \quad 0 \,.\, 1 \quad 1 \quad 0 \quad 1$

$= 2^3 \quad 2^2 \quad 2^1 \quad 2^0 \quad 2^{-1} \quad 2^{-2} \quad 2^{-3} \quad 2^{-4}$

$= (8+2) + (.5 + .25 + .0625)$

$= 10 + 0.8125$

$= (10.8125)_{10}$

[Exercise :- 1.10]

convert the following binary number to hexadecimal and decimal:

a) $(1.10010)_2$

Binary to decimal.

$(1.10010)_2 = (1.5625)_{10}$

$= 1 \,.\, 1 \quad 0 \quad 0 \quad 1 \quad 0$

$= 2^0 + 2^{-1} \quad 2^{-2} \quad 2^{-3} \quad 2^{-4} \quad 2^{-5}$

$= 1 + (.5 + 0.0625)$

$= 1 + .5625$

$= (1.5625)_2$

Binary to hexadecimal.

$(0001.1001\ 0000)_2 = (1.90)_{16}$

$1 \,.\, 9 \quad 0$

(b) :: $(110.010)_2 = (6.25)_{10} = (6.25)_{16}$

Sol:-

$(110.010)_2 = (6.25)_{10}$

$= \begin{matrix} 1 & 1 & 0 & . & 0 & 1 & 0 \\ 2^2 & 2^1 & 2^0 & . & 2^{-1} & 2^{-2} & 2^{-3} \end{matrix}$

$= (4+2) + (.25)$

$= 6 + .25$

$= (6.25)_{10}$

$(110.010)_2 = (6.4)_{16}$

$= \underbrace{0110}.\underbrace{0100}$

$= (6) + (.4)$

$= (6.4)_{16}$

The value of b is 4 times greater then a.

→ the value of (a) in binary to decimal is $(1.5625)_2$ and the value of (b) in binary to decimal is $(6.25)_{16}$

$(1.5625)_{10} \times 4 = (6.25)_{10}$

Hence proved.

$4(a)_{10} = (b)_{10}$

Exercise : 1.18

Perform subtraction on the given by 2's complement.

a) 10011 − 10010

Solution:–

In 2's complement first we take 1's complement

```
  1 0 0 1 1
− 1 0 0 1 0
     swipe
  1 0 0 1 1
+ 0 1 1 0 1
1 0 0 0 0 0
        + 1
```

2's complement = 1 0 0 0 0 1

b) 100010 − 100110

Solution:–

```
  1 0 0 0 1 0
− 1 0 0 1 1 0
       swipe
  1 0 0 0 1 0
```

1's complement + 0 1 1 0 0 1

1 1 1 0 1 1

2's complement.

```
1 1 1 0 1 1
        + 1
1 1 1 1 0 0
```

(c) 1001 − 110101

Sol:−

110101

one's complement − 1001 swipe

$$\begin{array}{r} 110101 \\ +\ 0110 \\ \hline 111011 \end{array}$$

2's complement

$$\begin{array}{r} 111011 \\ +1 \\ \hline \end{array}$$

2's complement = 111100

(d) 101000 − 10101

Sol:−

one's complement

101000

− 10101 swipe

$$\begin{array}{r} 101000 \\ +\ 01010 \\ \hline 110010 \end{array}$$

2's complement

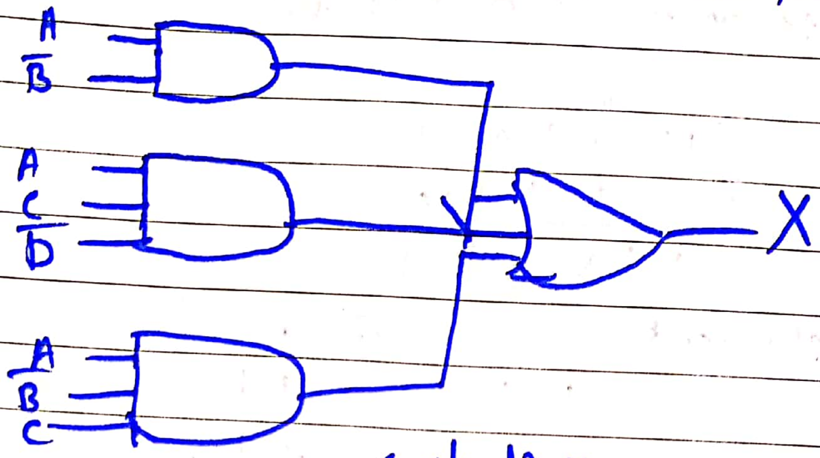
$$\begin{array}{r} 110010 \\ +1 \\ \hline \end{array}$$

2's complements = 110011

QNO6:-

First develop the Boolean Expression for the output of each gates network and simplify.

1.



Solution:-

$X = A\bar{B} + AC\bar{D} + A\bar{B}C$

$X = A\bar{B} + A\bar{B}C + AC\bar{D}$.

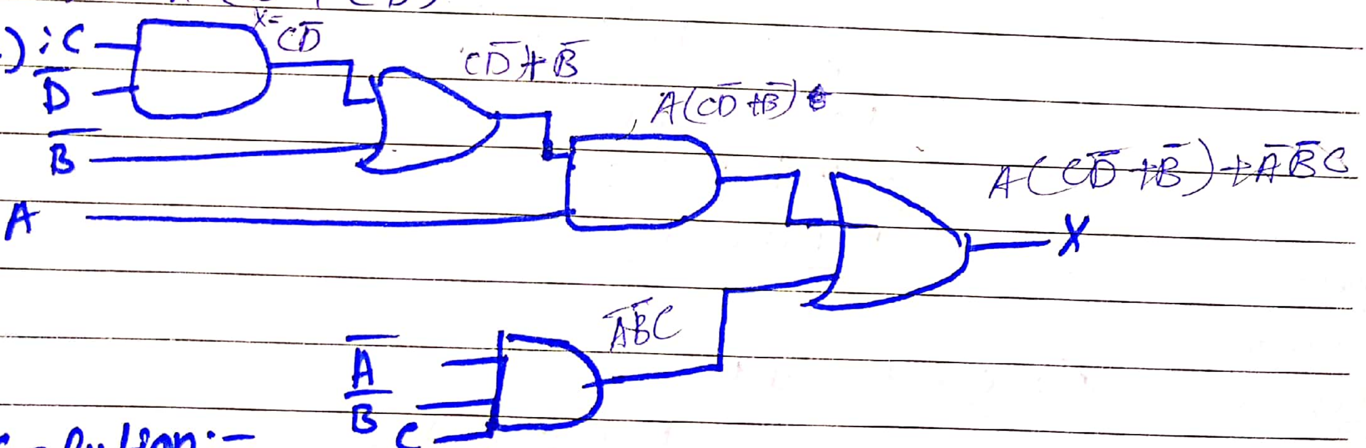
$X = A\bar{B}(1+C) + AC\bar{D}$ $\quad \because 1+C = 1$

$X = A\bar{B}(1) + AC\bar{D}$

$X = A\bar{B} + AC\bar{D}$

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

2):



Solution:-

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

$= AC\bar{D} + A\bar{B} + \bar{A}\bar{B}C$

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

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

$X = AC\bar{D} + \bar{B}A \Rightarrow \boxed{X = A(C\bar{D} + \bar{B})}$

Q No 7:-

Use Boolen Algebra, Simplify the following expressions

1: $\overline{AB}\,C + \overline{(A+B+\overline{C})}$

Solution:-

$= \overline{AB}\,C + \overline{(A+B+\overline{C})}$

$= \overline{A}\,\overline{B}\,C + \overline{A} + \overline{B} + \overline{\overline{C}}$

$= \overline{A}\,\overline{B}\,c + \overline{A} + \overline{B} + C$

$= (\overline{A}\,\overline{B}C + \overline{A}) + \overline{B} + C$

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

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

$= \overline{A} + \overline{B} + C$.

2:- $(A+\overline{A})(AB + AB\overline{C})$

Solution:-

$= (A+\overline{A})(AB + AB\overline{C})$

$= (1)(AB + AB\overline{C})$

$= AB + AB\overline{C}$

$= AB(1 + \overline{C})$

$= AB(1)$

$= AB$.

3:- $(B+BC)(B+\overline{B}C)(B+D)$.

Solution:-

$= B(1+C)(B+\overline{B}C)(B+D)$

$= B(1)(B+\overline{B}C)(B+D)$

$= B(B+\overline{B}C)(B+D)$

$= (B \cdot B + B\overline{B}C)(B+D) \Rightarrow [B + 0(C)](B+D)$

$= (B+0)(B+D) \Rightarrow B(B+D)$.

$\Rightarrow B \cdot B + BD \Rightarrow B + BD \Rightarrow B(1+D)$

$= B(1)$

$= B$.

QNO(8):-

Convert the following expression to sum-of-Product (SOP) forms.

$(A+B)(C+\overline{B})$

Solution:-

$= [(A+B)(C\overline{C})][(C+\overline{B})(A\overline{A})]$

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

$= ABC + A\overline{B}C + \overline{A}BC + \overline{A}\overline{B}C$.

$(A+C)(AB+AC)$

Sol:-

$= AAB + AAC + ABC + ACC$

$= (AB+AC)(1+C)$.

$= (AB+AC)1$

$= AB + AC$

$= ABC + AB\overline{C} + ABC + A\overline{B}C$.

$= ABC + A\overline{B}C + AB\overline{C}$

Convert each sop expression into standard so

$AB+CD$.

Sol:-

$= AB(C\overline{C})(D\overline{D}) + (CD)(A\overline{A})(B\overline{B})$

$= [(ABC)+(AB\overline{C})](D\overline{D}) + [(ACD)+(\overline{A}CD)](B\overline{B})$

$= (ABCD)+(ABC\overline{D})+(AB\overline{C}D)+(AB\overline{C}\overline{D}) + ABCD + A\overline{B}CD + \overline{A}BCD + \overline{A}\overline{B}CD$

$= ABCD + ABC\overline{D} + AB\overline{C}D + AB\overline{C}\overline{D} + A\overline{B}CD + \overline{A}BCD + \overline{A}\overline{B}CD$

$A+BD$:-

$= A(CBD)(\overline{C}\overline{B}\overline{D}) + BD(AC)(\overline{A}\overline{C})$

$= A\overline{B}\overline{C}\overline{D} + A\overline{B}\overline{C}D + A\overline{B}C\overline{D} + A\overline{B}CD + AB\overline{C}\overline{D} + AB\overline{C}D + ABC\overline{D} + ABCD + \overline{A}B\overline{C}D + \overline{A}BCD$.

QNO 9:-

Q:- Use a karnaugh map to find the minimum SOP form for each expressions.

$AB + A\bar{B}C + ABC$

Sol:

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

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

$= 111 \quad 110 \quad 101 \quad 111$

A \ BC	00	01	11	10
0				
1		1	1	1

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

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

$X = AC(\bar{B}+B) + AB\bar{C}$

$X = AC(1) + AB\bar{C}$

$X = AC + AB\bar{C}$ $\quad \therefore C + \bar{C}B = C$

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

$X = AC$

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

Sol:-

3-variable-K-Mapping.

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

000 101 011 110

A \ BC	00	01	11	10
0	1		1	
1		1		1

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

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

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

$X = \bar{B}(1) + B(1)$

$X = \bar{B} + B$

$X = 1$

$X = AC[\bar{B} + B(B+\bar{C})]$

Sol:-

$= AC[\bar{B} + B.B + B\bar{C})]$

$= AC[\bar{B} + B + B\bar{C})]$

$= AC[\bar{B} + B + B\bar{C}]$

$= AC\bar{B} + AB\bar{C}C + ABC$

$= AC\bar{B} + AB(0) + ABC$

$X = A\bar{B}C + 0 + ABC$

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

101 111

A \ BC	00	01	11	10
0				
1		1	1	

$X = AC(\bar{B} + B)$

$X = AC(1) \Rightarrow X = AC$

- $\bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + ABCD + ABC\bar{D}$

Sol:-

$X = \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + ABCD + ABC\bar{D}$

0000   0001   1111   1110

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

$X = \bar{A}\bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{C}D + ABCD + ABC\bar{D}$

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

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

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

$X = 1$

- $Y = (A+B+C')(A+B'+C')(A'+B'+C)(A'+B'+C')$

Sol:-

$Y = (A+B+C')(A+B'+C')(A'+B'+C)(A'+B'+C')$

$= (1\ 1\ 0)(1\ 0\ 0)(0\ 0\ 1)(0\ 0\ 0)$

A \ BC	00	01	11	10
0	1	1		
1	1			1

ABC   ABC   ABC

000   1 0 0   001

100   1 1 0

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

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

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

$$F(A,B,C,D) = \pi(3,5,7,8,10,11,12,13).$$

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

$$X = \bar{A}\bar{B}CD + \bar{A}B\bar{C}D + \bar{A}BCD + AB\bar{C}\bar{D} + AB\bar{C}D + \bar{A}\bar{B}CD + AB\bar{C}D + \bar{A}\bar{B}C\bar{D}$$

$$F(A,B,C,D) = M(6,7,8,9) \text{ and } d(12,13,14,15)$$

sol:-

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

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

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

$$= 1 + 1$$

$$= 1$$

$$d(12,13,14,15)$$

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

$$X = AB\bar{C}\bar{D} + AB\bar{C}D + ABCD + ABC\bar{D}$$

$$X = AB\bar{C}\bar{D} + ABCD + AB\bar{C}D + ABC\bar{D}$$

$$X = AB(\bar{C}\bar{D} + CD) + ABC(\bar{C}D + C\bar{D})$$

$$X = ABCD + ABCD$$

$$= AB + AB$$

$$\boxed{X = AB.}$$