Questionmates

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fundamenatals of digital circuit.

digital → language $(\overset{low}{0}, \underset{high}{1})$.

combination of (0,1)

convey, represent any thing.

AND operation.

ANDing opposite → NAND. (they perform opposite function).

AND	NAND
0	1
1	0.

OR → NOR.

NOT/inverter/complement

Ex-OR → Ex NOR. (all others are basic).

Ex OR → combination of basic.

gate → component that can do certain opⁿ.

Any no of Input are possible.

A, B. (2 Input, 2bit, 2^4) apply ANDing.

0 0	=	0
0 1	=	0
1 0	=	0
1 1	=	1

out will be high if and only if all the Input is high.

A	B	AND	NAND
0	0	0	1
0	1	0	1
1	0	0	1
1	1	1	0

OR → give 1 as out put
Input is 1

NOR (If any one of the Input is one the out-put will be 0).

A	B	OR	NOR
0	0	0	1
0	1	1	0
1	0	1	0
1	1	1	0

ExOr.

count for ① of Input
odd → 1
even → 0

A	B	ExOr
0	0	0
0	1	1
1	0	1
1	1	0

No. of ① is
odd → 0
even → 1

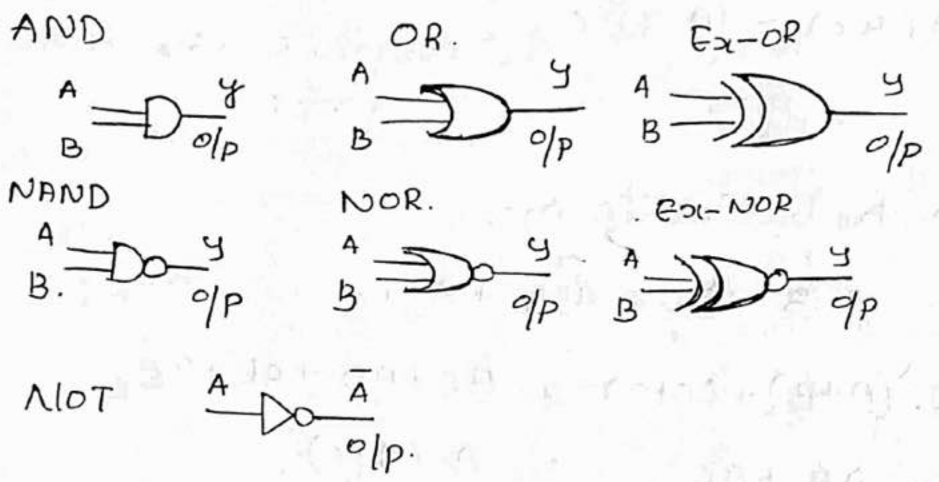
A	B	ExNOR
0	0	1
0	1	0
1	0	0
1	1	1

NOT / inverter / complement

Input (A)	out put (NOT)
0	1
1	0

Table
Table which shows the relaⁿ b/w Input and out put is called truth table.

Symbolic representation



(opp, complem

$A \rightarrow \bar{A}$

$B \rightarrow \bar{B}$

AND

$y = AB.(A \cdot B).$

OR

$y = A + B$

Ex-OR

$y = A \oplus B.$

NOT

$y = \bar{A}$

NAND

$y = \overline{AB}$

NOR

$y = \overline{A+B}$

Ex-NOR

$y = \overline{A \oplus B}$

$= A \odot B$

Laws of Boolean Algebra.

→ $A + 0 = A$ (if one put of or is 0 then out put will other input)

→ $A + 1 = 1$ (Oorennam 1 aanu so 1

→ $A + A = A$

→ $A + \bar{A} = 1$

→ $A \cdot 0 \rightarrow 0$

→ $A \cdot 1 \rightarrow A$

→ $A \cdot A \rightarrow A$

→ $A \cdot \bar{A} \rightarrow 0$

$1 + 0 = 0 + 1$

$1 \cdot 0 = 0 \cdot 1$

Boolean theorems.

$A + B = B + A$

$A \cdot B = B \cdot A$ → commutative law

$A+B+C = (A+B)+C$ → Associative law.

$A(B\cdot C) = (A\cdot B)\cdot C$ no significance which you groups.

Distributive law.

1. $A\cdot(B+C) = A\cdot B + A\cdot C$.

2. $(A+B)+(C+D) = AC+AD+BC+BC$

3. $AB+AC = A\cdot(B+C)$

Universal – NAND and NOR

De morgan's law

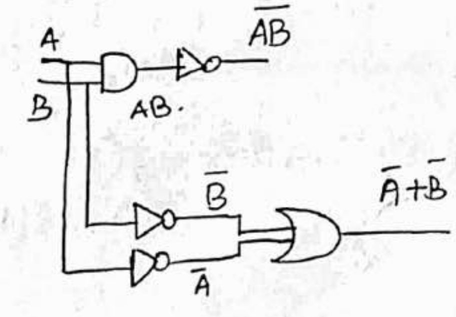
$\overline{AB}$

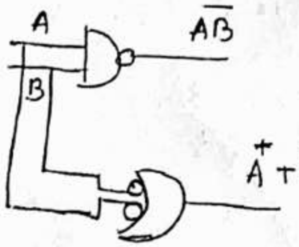
A – First Input

B → second Input.

$(\_) = 'o'$ ('–) represent complement 'o' represent complement in diagram).

$\overline{AB} = \bar{A}+\bar{B}$ (LHS).

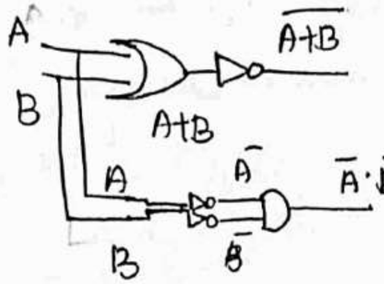


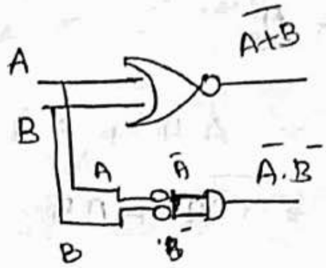


$\boxed{\bar{A}+\bar{B} \neq \overline{A+B}}$

$\overline{A+B} = \overline{A} \cdot \overline{B}$

Draw the diagram.





f(A,B,C) =

$ABC + \overline{A}\overline{B}C + A\overline{B}C$ (product summed) → SOP

f(A,B,C) =

$(A+B+C)\ (A+\overline{B}+C)\ (\overline{A}+\overline{B}+C)$ (summed and product) → POS.

SOP - combination of product

POS → combination of sums.

Both SOP & POS contain 3 terms

SOP - minterm

POS - maxterm.

It is need to mention all the input whether it is in compliment or non compliment form. then it is a minterm or maxterm.

Σ - SOP, minterm.

π - POS, maxterm.

There are two type of boolean algebra.

→ std or cannonical. (all terms are minterm or maxterm)

→ non std or noncannonical (all terms are not minterm or maxterm)

If it is some other... [we] need to incoperate it into it.

① $A + AB = A(1+B)$

$= A \cdot 1$

$= \underline{\underline{A}}$

② $A(A+B) = A \cdot A + AB$

$= A + AB$

$= A(1+B)$

$= A \cdot 1$

$= \underline{\underline{A}}$

3 $A(\bar{A}+B) = A \cdot \bar{A} + A \cdot B$

$= 0 + A \cdot B$

$= \underline{\underline{AB}}$

④ prove $A + (\bar{A} \cdot B) = (A+B)$

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

$= AA + A\bar{A} + BA + B\bar{A}$

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

$A(1+B) + \bar{A}B$

$= \underline{\underline{A + (\bar{A} \cdot B)}}$ hence proved.

2 $(A+B)(A+\bar{B})$

$= AA + A\bar{B} + BA + B\bar{B}$

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

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

$= A(1)$

$= \underline{\underline{A}}$

3 $(A+C)(\bar{A}+B) =$

$= A\bar{A} + AB + \bar{A}C + BC = 0$

$= 0 + AB + \bar{A}C + BC = 0$

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

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

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

$= \underline{\underline{AB + \bar{A}C}}$

4 $AB + \bar{A}C + BC$

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

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

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

$= \underline{\underline{AB + \bar{A}C}}$

5 $A\bar{C} + AB\bar{C}$

$\bar{C}(A + AB)$

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

$\bar{C}(A \cdot 1)$

$= \underline{\underline{A\bar{C}}}$

6 $\bar{A}\bar{B}C\bar{D} + \bar{A}\bar{B}\bar{C}\bar{D}$

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

$= \underline{\underline{\bar{A}\bar{B}\bar{D}}}$

7 $\overline{(\bar{A}+C)(B+\bar{D})} =$ $\overline{AB} = \bar{A}+\bar{B}$

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

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

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

8. $\overline{(A+B)}\,\overline{(\bar{A}+\bar{B})}$

$(\bar{A}\cdot\bar{B})(A\cdot B)$

$A\bar{A}\cdot\bar{A}B + \bar{B}A + \bar{B}B$

$= \underline{\underline{0}}$

1. $y(A,B,C) = \Sigma_m(0,1,3,4,7)$

$0\ 0\ 0 \quad \bar{A}\bar{B}\bar{C}$

$0\ 0\ 1 \quad \bar{A}\bar{B}C$

$0\ 1\ 1 \quad \bar{A}BC$

$1\ 0\ 0 \quad A\bar{B}\bar{C}$

$1\ 1\ 1 \quad ABC.$

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

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

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

2. $y(A,B,C) = \Sigma_m(0,1,2,3,4,5,6,7)$

$000 \quad \bar{A}\bar{B}\bar{C}$

$001 \quad \bar{A}\bar{B}C$

$010 \quad \bar{A}B\bar{C}$

$011 \quad \bar{A}BC$

$100 \quad A\bar{B}\bar{C}$

$101 \quad A\bar{B}C$

$1\,\cancel{0}10 \quad AB\bar{C}$

$111 \quad ABC$

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

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

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

$(AB\bar{C}) + (ABC).$

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

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

$= \bar{A}+A = \underline{\underline{1}}$

3. $y(A,B,C) = \Sigma_m (0,2,4,6)$

$000 \quad \bar{A}\bar{B}\bar{C}$

$010 \quad A\bar{B}\bar{C}$

$100 \quad A\bar{B}\bar{C}$

$110 \quad AB\bar{C}$

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

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

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

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

5. $(\bar{A}+B)(A+B+D)\bar{D}$

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

$= \bar{A}A\bar{D} + \bar{A}B\bar{D} + 0 + BA\bar{D} + BB\bar{D}$

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

$= B\bar{D} + B\bar{D}$

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

$= \underline{\underline{B\bar{D}}}$

4. $\cancel{y(A,B,C) = \Pi_m(1,3,5,7)}$.

$\cancel{001 \quad \bar{A}+\bar{B}+C}$

$\cancel{011 \quad \bar{A}+B+C}$

$\cancel{101 \quad \bar{A}+B+\bar{C}}$

$\cancel{111 \quad \bar{A}+\bar{B}+\bar{C}}$

4. $Y(ABC) = \pi M(1,3,5,7)$

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

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

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

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

$= (A+A\bar{B}+A\bar{C}+AB+0+B\bar{C}+A\bar{C}+\bar{B}\bar{C}+0)(\bar{A}+\bar{A}\bar{B}$

$+\bar{A}\bar{C}+B\bar{A}+0+B\bar{C}+\bar{A}\bar{C}+\bar{B}\bar{C}+0)$

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

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

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

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

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

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

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

$0+AC+A\bar{A}\bar{C}+\bar{A}\bar{C}B+A\bar{C}\bar{C}+B\bar{C}\bar{C}$

K map or Karnaugh map

2. variable – A, B y(A, B) → 2 bits → $2^n = 2^2 = 4$ no. of combination.

Here we consider SOP

A \ B	0 $\bar{B}$	1 B
$\bar{A}$ 0	00 0	01 1
A 1	10 2	11 3

— cell

we have 4 cell. here.

y(A, B, C)

A \ BC	$\bar{B}\bar{C}$ 00	$\bar{B}C$ 01	BC 11	$B\bar{C}$ 10
$\bar{A}$ 0	000 0	001 1	011 3	010 2
A 1	100 4	101 5	111 7	010 6

BC
00
01
10
11

y(A, B, C, D) – 4 bit – 16 comb^n. 16 cell

AB \ CD	00	01	11	10
00	0000 0	0001 1	0011 3	0010 2
01	0100 4	0101 5	0111 7	0110 6
11	1100 12	1101 13	1111 15	1110 14
10	1000 8	1001 9	1011 11	1010 10

Here Interchange happens due to this is not a binary it is grey code

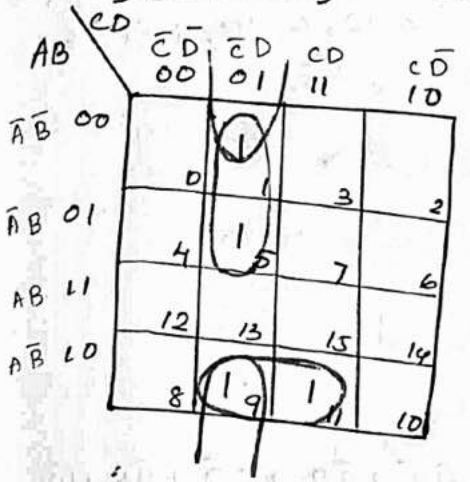
0 1 3 2
4 5 7 6
12 13 15 14
8 9 11 10

A \ B	0 $\bar{B}$	1 B
$\bar{A}$ 0	0	1
A 1	2	3

A \ BC	$\bar{B}\bar{C}$ 00	$\bar{B}C$ 01	BC 11	$B\bar{C}$ 10
$\bar{A}$ 0	0	1	3	2
A 1	4	5	7	6

AB \ CD		$\bar{C}\bar{D}$ 00	$\bar{C}D$ 01	CD 11	$C\bar{D}$ 10
$\bar{A}\bar{B}$	00	0	1	3	2
$\bar{A}B$	01	4	5	7	6
AB	11	12	13	15	14
$A\bar{B}$	10	8	9	11	10

$y(A,B,C,D) = \Sigma m\,(1,5,9,11)$ Sop (1 are assined to min terms)



we can include 1 cell in more than 1 group

containing all cells are need to grouped.

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

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

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

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

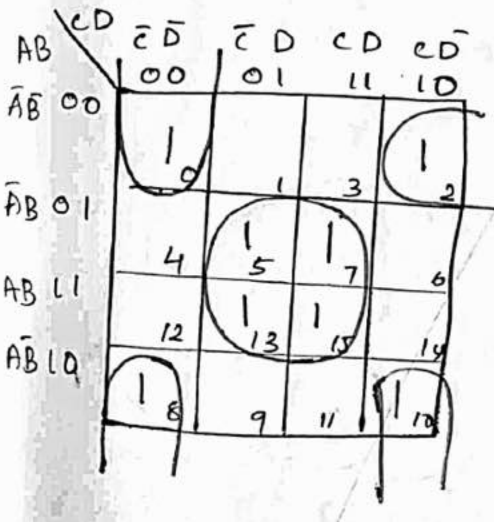
$= D + \bar{A} + A\bar{B}$

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

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

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

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



$y(A,B,C,D) = \Sigma m\,(5,7,13,15,0,2,8,10)$

$= D + B + \bar{B} + \bar{D}$

$D + \bar{D} + B + \bar{B}$

$1 + 1$

$= \underline{1}$

$y(A,B,C,D) = \Sigma m = (4,12,6,14,3,2,7,6,0,8)$

$$y(A,B,C,D) = \Sigma m(4,12,6,14,3,2,7,0,8).$$

AB \ CD	00 $\bar{C}\bar{D}$	01 $\bar{C}D$	11 CD	10 $C\bar{D}$
00 $\bar{A}\bar{B}$	1 (0)	(1)	1 (3)	1 (2)
01 $\bar{A}B$	1 (4)	(5)	1 (7)	1 (6)
11 AB	1 (12)	(13)	(15)	1 (14)
10 $A\bar{B}$	1 (8)	(9)	(11)	(10)

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

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

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

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

Simplify

$$y(A,B,C,D) = \Sigma_m(1,3,7,11,15) + d(0,2,5)$$

don't care.

AB \ CD	$\bar{C}\bar{D}$ 00	$\bar{C}D$ 01	CD 11	$C\bar{D}$ 10
00 $\bar{A}\bar{B}$	1 (0)	1 (1)	1 (3)	1 (2)
01 $\bar{A}B$	(4)	1 (5)	1 (7)	(6)
11 AB	(12)	(13)	1 (15)	(14)
10 $A\bar{B}$	(8)	(9)	1 (11)	(10)

we need to consider don't care if it reduce the size of eqn.

$\bar{A}\bar{B}(\bar{D}+D) + \bar{A}D + CD$

$= \bar{A}\bar{B} + \bar{A}D + CD$

$\bar{A}\bar{B} + CD$

$y(A,B,C,D) = \Sigma m(0,1,2,3,5,7,8,9,11,14)$

$$y(ABCD) = \sum m(1,3,5,8,9,11,15) + d(2,13)$$

1.

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

$(8,9) \rightarrow A\bar{B}\bar{C}$

$(1,5,13,9) \rightarrow \bar{C}D$

$(13,15,9,11) \rightarrow AD$

$(1,3,9,11) \rightarrow \bar{B}D$

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

$$y(ABCD) = \sum m(0,1,2,3,5,7,8,9,11,14)$$

2.

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

$(0,1,3,2) \rightarrow \bar{A}\bar{B}$

$(1,3,5,7) \rightarrow \bar{A}D$

$(0,1,8,9) \rightarrow \bar{B}\bar{C}$

$(1,3,9,11) \rightarrow \bar{B}D$

$14 \rightarrow ABC\bar{D}$

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

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

3.

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

$$y(ABCD) = (0,2,4,7,8,10,12,13)$$

$(0,4,12,8) \rightarrow \bar{C}\bar{D}$

$(0,2,8,10) \rightarrow \bar{B}\bar{D}$

$(12,13) \rightarrow AB\bar{C}$

$(7) \rightarrow \bar{A}BCD$

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

POS $y_{(A,B,C,D)} = \pi_m(1,3,5,8,9,11,15) + d(2,13)$

AB \ CD	$\bar{C}\bar{D}$ 00	$\bar{C}D$ 01	CD 11	$C\bar{D}$ 10
$\bar{A}\bar{B}$ 00	0	0 $_1$	0 $_3$	m= 0 $_2$
$\bar{A}B$ 01	4	0 $_5$	7	6
AB 11	12	m= 0 $_{13}$	0 $_{15}$	14
$A\bar{B}$ 10	0 $_8$	0 $_9$	0 $_{11}$	10

1 2 3

$m_1 =$

AB \ CD	CD 00	$C\bar{D}$ 01	$\bar{C}\bar{D}$ 11	$\bar{C}D$ 10
AB 00	0	0 $_1$	0 $_3$	0 $_2$
$A\bar{B}$ 01	4	0 $_5$	7	6
$\bar{A}\bar{B}$ 11	12	0 $_{13}$	0 $_{15}$	14
$\bar{A}$ B 10	0 $_8$	0 $_9$	0 $_{11}$	10

$m_1\ (8,9) \Rightarrow (\bar{A}+\bar{B}+C)$

$m_2\ (1,5,13,9) \Rightarrow (\bar{A}+A+C+\bar{D})$

$m_3\ (13,15,9,11) \Rightarrow (\bar{A}+\bar{D}+C+\bar{C})$

$m_4\ (1,3) \Rightarrow (A+B+\bar{D})$

$y(ABCD) = \pi_M (0, 1, 3, 5, 6, 7, 9, 10\}, 11, 12, 13, 15)$

AB \ CD	CD 00	$C\bar{D}$ 01	$\bar{C}\bar{D}$ 11	$\bar{C}D$ 10
AB 00	0 (0)	0 (1)	0 (3)	(2)
$A\bar{B}$ 01	(4)	0 (5)	0 (7)	0 (6)
$\bar{A}\bar{B}$ 11	0 (12)	0 (13)	0 (15)	(14)
$\bar{A}B$ 10	(8)	0 (9)	0 (11)	0 (10)

$(0,1) \Rightarrow A+B+C+1$

$(1,3,5,7) \Rightarrow A+\bar{D}+1$

$(13, 15, 9, 11) \Rightarrow \bar{A}+\bar{D}+1$

$(12, 13) \Rightarrow \bar{A}+\bar{B}+C+1$

$(11, 10) \Rightarrow \bar{A}+\bar{B}+\bar{C}+1$

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

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

$\pi_M (1, 2, 3, 5, 6, 7, 9, 10, 11, 13, 14, 15)$

AB \ CD	CD 00	$C\bar{D}$ 01	$\bar{C}\bar{D}$ 11	$\bar{C}D$ 10
00 AB	(0)	0 (1)	0 (3)	0 (2)
01 $A\bar{B}$	(4)	0 (5)	0 (7)	0 (6)
11 $\bar{A}\bar{B}$	(12)	0 (13)	0 (15)	0 (14)
10 $\bar{A}B$	(8)	0 (9)	0 (11)	0 (10)

$= \bar{D}+\bar{C}$

$= \bar{D}\bar{C}$

$y(A,B,C,D) = \sum m(0,1,3,7) + d(2,5)$

AB \ CD	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	1_0	1_1	1_3	1_2
$\bar{A}B$	4	1_5	1_7	6
AB	12	13	15	14
$A\bar{B}$	8	9	11	10

$(0,1,3,2) \rightarrow \bar{A}\bar{B}$

$(1,3,5,7) \rightarrow \bar{A}D$

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

$y(ABC) = \sum m(0,1,3,7) + d(2,5)$

A \ BC	$\bar{B}\bar{C}$	$\bar{B}C$	BC	$B\bar{C}$
$\bar{A}$ 0	1_0	1_1	1_3	1_2
A 1	4	1_5	1_7	6

$(0,1,3,2) \rightarrow \bar{A}$

$(1,3,5,7) \rightarrow C$

$= \bar{A} + C$

$y(A,B,C,D) = (1,3,7,11,15) + d(0,2,4)$

AB \ CD	$\bar{C}\bar{D}$	$\bar{C}D$	CD	$C\bar{D}$
$\bar{A}\bar{B}$	1_0	1_1	1_3	1_2
$\bar{A}B$	1_4	5	1_7	6
AB	12	13	1_{15}	14
$A\bar{B}$	8	9	1_{11}	10

$(0,1,3,2) \rightarrow \bar{A}\bar{B}$

$(3,7,15,11) \rightarrow CD$

$= \bar{A}\bar{B} + CD$

$y(ABCD) = \Sigma m($

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

$(1,9) \rightarrow \bar{B}\bar{C}D$

$(4) \rightarrow \bar{A}B\bar{C}\bar{D}$

$(10,11,14,15) \rightarrow AC$

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

$y(ABCD) = \Sigma m(0,1,3,5,6,7,9,10,11,12,13,15)$

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

$(0,1) \rightarrow \bar{A}\bar{B}\bar{C}$

$(12,13) \rightarrow AB\bar{C}$

$(11,10) \rightarrow A\bar{B}C$

$(7,6) \rightarrow \bar{A}BC$

$(1,3,5,7,13,15,9,11) \rightarrow D.$

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

$y(A,B,C,D) = \Pi M(1,2,3,8,9,10,11,14) \cdot d(7,15)$

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

$(1,3,9,11) \rightarrow (\bar{D}+B)$

$(3,2,11,10) \rightarrow (\bar{C}+B)$

$(8,9,10,11) \rightarrow (\bar{A}+B)$

$(3,7,15,11) \rightarrow (\bar{C}+\bar{D})$

$(15,14,11,10) \rightarrow (\bar{A}+\bar{C})$

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

In case of anding if 1 input is 1 then the out put is the other input.

In case of oring operation If 1 input is 0 then the output is the other input.

<u>standard or canonical form</u>-

If all the terms are minterm (SOP) or maxterm (POS). then it is called standard or canonical form.

minterm and max term - consist all the input variable either in its orginal and or in complement form.

$$Y(A,B,C) = \underbrace{ABC}_{} + B\bar{C} + A\bar{B}$$

minterm.

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

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

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

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

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

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