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

$= (B+0)(B+D)$

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

$\rightarrow (\bar{A}\cdot\overline{BC})(A\bar{B}+ABC)$

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

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

$= \bar{A}BC.A\bar{B} + \bar{A}BCABC$

$= 0 + \bar{A}BCABC$

$= 0+0 = 0$

→ Boolean ~~function~~ expression and their representation:-

- SOP:- Sum of products
- POS:- Product of sum
- canonical form:-
  - SSOP (Standard sum of products)
  - SPOS (Standard product of sum)

→ SOP :- SOP is a group of product terms sumed together.

ex. -

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

here, AB, BC and $\bar{A}\bar{B}\bar{C}$ are product term.

SOP is also called Disjunctive Nominal form.

→ POS :- POS is a group of sum terms multiplied together.

ex. -

$(A+B)(A+C)$

here, $(A+B)$ and $(A+C)$ is sum term.

It is also called Conjunctive normal form.

→ Canonical form :-

SSOP	SPOS
Each product terms contains all the variable of the function	Each sum terms contains all the variables of the function
ex.-	ex -
$f(A,B,C) = \bar{A}BC + ABC$	$f(A,B,C) = (A+B+\bar{C})(\bar{A}+\bar{B}+C)$

→ How to convert SOP to SSOP:-

Step 1:- Indentify the missing variable in product term.

Step 2:- multiply (variable and its compliment. $(C+\bar{C}) = 1 = (A+\bar{A}) = (B+\bar{B})$

Step 3:- neglect the repeat terms.

ex.-

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

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

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

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

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

→ Convert POS to SPOS :-

Step 1 :- Identify the missing variable.

Step 2 :- add the variable and it's compliment separately.

Step 3 :- neglect the repeted terms.

ex.-

$F(A,B,C) = (A+B)(B+C)$

~~$= (A+B+D)(B+C+D)$~~

~~$A+B+C$~~

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

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

Minterm	Maxterm
• Each individual product term in SSOP is called minterm.	• Each individual sum term in SPOS is called maxterm.
ex. -	ex. -
$F(A,B) = \underbrace{A\bar{B} + \bar{A}B}_{\text{minterm}}$	$F(A,B) = \underbrace{(A+B)(\bar{A}+\bar{B})}_{\text{maxterm}}$
$F(A,B,C) = A\bar{B}C + \bar{A}BC + A\bar{B}C$	$F(A,B,C) = (A+B+C)(\bar{A}+B+\bar{C})$
each term is minterm.	each term is maxterm.

NOTE:- We consider A as 1 and $\bar{A} = 0$, means for '0' bar comes, for '1' no bar in case of minterm.

	Variable		Minterm	Max term
	A	B	SSOP	SPOS
FOR 2 variables	0	0	$\bar{A}\bar{B} \rightarrow m_0$	$M_0 \leftarrow A+B$
	0	1	$\bar{A}B \rightarrow m_1$	$M_1 \leftarrow A+\bar{B}$
	1	0	$A\bar{B} \rightarrow m_2$	$M_2 \leftarrow \bar{A}+B$
	1	1	$AB \rightarrow m_3$	$M_3 \leftarrow \bar{A}+\bar{B}$

NOTE:- We consider A as 0 and $\bar{A}=1$ for max term.

Variable			Minterm	Maxterm
A	B	C	SSOP	SPOS
0	0	0	$\bar{A}\bar{B}\bar{C} \leftarrow m_0$	$A+B+C$
0	0	1	$\bar{A}\bar{B}C \leftarrow m_1$	$A+B+\bar{C}$
0	1	0	$\bar{A}B\bar{C} \leftarrow m_2$	$A+\bar{B}+C$
0	1	1	$\bar{A}BC \leftarrow m_3$	$A+\bar{B}+\bar{C}$
1	0	0	$A\bar{B}\bar{C} \leftarrow m_4$	$\bar{A}+B+C$
1	0	1	$A\bar{B}C \leftarrow m_5$	$\bar{A}+B+\bar{C}$
1	1	0	$AB\bar{C} \leftarrow m_6$	$\bar{A}+\bar{B}+C$
1	1	1	$ABC \leftarrow m_6$	$\bar{A}+\bar{B}+\bar{C}$

here, suffix with 'm' is related to binary value of variable, it will not change if we change the orders.

Q. Find out the minterm.

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

→

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

here, $AB \Rightarrow 11 \rightarrow 3$

$\bar{A}B \Rightarrow 01 \rightarrow 1$

$= \Sigma m(3,1)$

So, minterm for expression is 3,1

now for 2 variable values are 0, 1, 2, 3 and 3 and 1 is minterm so, maxterm for expression is

$\pi M[0, 2]$

Q. $f(A,B) = \bar{A} + \bar{B}$ Calculate maxterm.

$= \pi M[3]$

$\bar{A} + \bar{B} \rightarrow 1\ 1 \rightarrow 3$

So minterms is $\Sigma m(0, 1, 2)$

Q. $f(A,B) = \bar{A} + \bar{B}$

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

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

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

now, for minterm

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

$= m_1 + m_2 + m_0$

$= \Sigma m(0, 1, 2)$

So, minterm for expression is 0, 1 and 2

hence, maxterm is 3.

maxterm $= \pi M[3]$

$f(A,B,C,D) = A + B\bar{C} + AB\bar{D} + ABCD$

→ Since, it is not SSOP so,

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

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

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

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

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

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

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

$= \Sigma m(4, 5, 8, 9, 10, 11, 12, 13, 14, 15)$

So, maxterm $= \pi M(0, 1, 2, 3, 6, 7)$

Lab

Study of logical gates

input

up - 1 → Green
down - 0 → red

Pin no-7-Ground
Pin-No-14-Vcc

Output

1 - On LED
0 - off LED

IC-7408 for AND Gate
IC-7432 for OR Gate
IC-7404 for NOT Gate
IC-7400 for NAND Gate
IC-7402 for NOR Gate
IC-7486 for XOR Gate

Vertual lab