SOP & POS

- **Sum-of-Products (SOP) Expression**: a product term or a logical sum (OR) of several product terms.

  Examples: x, x+yz', xy'+x'yz, AB+A'B'

- **Product-of-Sums (POS) Expression**: a sum term or a logical product (AND) of several sum terms.

  Examples: x, x(y+z'), (x+y')(x'+y+z), (A+B)(A'+B')

- Every boolean expression can either be expressed as sum-of-products or product-of-sums expression.

  Examples:

  SOP: x'y + xy' + xyz

  POS: (x + y')(x' + y)(x' + z')

MIN & MAX TERM

- Minterms are sum terms.
- For Boolean functions, the minterms of a function are the terms for which the result is 1.
- Boolean functions can be expressed as sum of-Minterms
- Maxterms are Product terms.
- For Boolean functions, the maxterms of a function are the terms for which the result is 0.
- Boolean functions can be expressed as Products-of-Maxterms.

	A	B	C	F
0	0	0	0	1
1	0	0	1	1
2	0	1	0	0
3	0	1	1	0
4	1	0	0	1
5	1	0	1	1
6	1	1	0	0
7	1	1	1	0

Min Terms : 0,1,4,5
[000,001,100,101]
F=∑(0,1,4,5)

Max Terms : 2,3,6,7
[010,011,110,111]
F=□(2,3,6,7)

MIN-SOP and MAX-POS

Minterms				Maxterms	
x	y	term	notation	term	notation
0	0	x'y'	m0	x+y	M0
0	1	x'y	m1	x+y'	M1
1	0	xy'	m2	x'+y	M2
1	1	xy	m3	x'+y'	M3

Each minterm is the complement of the corresponding maxterm:
Example: m2 = xy' m2' = (xy')' = x' + (y')' = x'+y = M2

	A	B	C	F
0	0	0	0	1
1	0	0	1	1
2	0	1	0	0
3	0	1	1	0
4	1	0	0	1
5	1	0	1	1
6	1	1	0	0
7	1	1	1	0

Min Terms : 0,1,4,5
[000,001,100,101]
F=∑(0,1,4,5)
F=A'B'C'+A'B'C+AB'C'+AB'C
(A'+B'+C')

Max Terms : 2,3,6,7
[010,011,110,111]
F=□(2,3,6,7)
F=(A+B'+C)(A+B'+C')(A'+B'+C)

Conversion between MIN & MAX

F2 = ∑(m1,m4,m5,m6,m7)

x	y	z	F2	F2'
0	0	0	0	1
0	0	1	1	0
0	1	0	0	1
0	1	1	0	1
1	0	0	1	0
1	0	1	1	0
1	1	0	1	0
1	1	1	1	0

The complement function of F2 is:
F2' =∑ (m0,m2,m3) = m0 + m2 + m3

F2 = (m0 + m2 + m3)'
= m0' . m2' . m3'
= M0 . M2 . M3
= □(M0,M2,M3)

Every Boolean function can be expressed as either Sum-of-Minterms or Product-of-Maxterms.

Simplified Function to SOP & POS

How to Convert into SOP:

Check if each term contains all variable, if not then AND (x+x') if x is the missing term

Simplified Function, F=A+B'C

F=A+B'C
=A(B+B')(C+C')+B'C(A+A')
=(AB+AB')(C+C')+B'C(A+A')
=AB(C+C')+AB'(C+C')+B'C(A+A')
=ABC+ABC'+AB'C+AB'C'+AB'C+A'B'C
=ABC+ABC'+AB'C+AB'C'+A'B'C
=∑(1,4,5,6,7)

How to Convert into POS:

1.Often distributive law (x+yz)=(x+y)(x+z)) is used
2.If then terms, like x, are missing, OR xx'
3.Each POS is missing a term so OR missing terms
Again applying distributive law

Simplified Function, F=A+B'C
F=A+B'C
= (A+B')(A+C)
=(A+B'+CC')(A+BB'+C)
={(A+B')+C}{(A+B')+C'}{(A+C)+B}{(A+C)+B'}
=(A+B'+C)(A+B'+C')(A+B+C)(A+B'+C)
=(A+B'+C)(A+B'+C')(A+B+C)
=□(2,3,0)
=□(0,2,3)