**Product -of- sum representation of logic function :**

 A PS is a sum term or several sum terms logically multiplied together e.g. :

F = (A+B)(A+B+C)(A+D)…..

**Derivation of PS :**

1-construct the T.T.

2-construct a sum column of sum of all inputs ( 0=uncomplement , 1=complement)

3-The desired output exp. Is the product of the sum of all terms in which the output

 is zero.

***EX:*** For the following T.T. , write the logic function using PS method :

 Z S. treams Max terms AB

 00 1 (A+B) M0

 01 0 (A+B) M1

 10 0 (A+B) M2

 11 0 (A+B) M3

Z= M1 . M2 . M3

 = (A+B)(A+B)(A+B)

***EX***: Simplify the following function using SP and PS methods :

 F(A,B,C) = π( M2 , M3 , M6 )

Sol:

 ABC Z

 000 1 m0

 001 1 m1

 010 0 M2

 011 0 M3

 100 1 m4

 101 1 m5

 110 0 M6

 111 1 m7

**1-By SP method :**

Z = m0 + m1 + m4 + m5 + m7

 = ABC + ABC + ABC +ABC + ABC

 = AB(C+C) + AB(C+C) + ABC  A

 = AB + AB + ABC C

 = B(A+A) + ABC B Z

 = B + BAC

Z = B + AC

**2- By PS method :**

Z = M2.M3.M6

 =(A+B+C)(A+B+C)(A+B+C)

 =(A+B+C)(A+B+C)(A+B+C)(A+B+C)

 =(AA+BA+CA+AB+BB+CB+AC+BC+CC)

 =(A+BA+CA+AB+B+CB+AC+BC).(

 =(A(1+B+C+B+C)+B(1+C+C)).(

 =(A+B)(AA+BA+CA+AB+BB+CB+AC+BC+CC)

 =(A+B)(BA+CA+AB+B+CB+AC+BC+C)

 =(A+B)(B(A+A+1+C+C)+C(A+A+1))

 =(A+B)(B+C)

  A

 B

 z

 C

PS method require one more gate than SP .

**Logic circuit design using NAND and NOR gates only :**

 There are many reasons for using NAND and NOR gates only to implement any logic function :

1-NAND and NOR gates are simpler, cheaper and have a faster response time to input changes , and consume less power .

2-The ability to implement any logic function using NAND or NOR gates only is easier than implement three different logic gates .

By using De morgan's theorem we can apply any logic circuit using NAND or NOR gates only.

**Using NAND gates :**

***EX***: Simplify the following function and implement the final equation using NAND gates only :

 H(A,B,C) = Σ (0,1,4,6,7)

 H= ABC + ABC + ABC + ABC + ABC

 = AB(C+C) + ABC + AB(C+C)

 = AB + ABC + AB

 = B(A+AC) + AB

 = B(A+C) + AB

 = BA + BC +AB