

## → Karnaugh map [K-map]

It is used to simplify boolean algebra expressions without boolean rules or theorems.

### K map for two variable -

$\backslash A$	0	1
B		
0		
1		

$$\left[ \begin{array}{l} \text{no. of cells in K map} = 2^n \\ n = \text{no. of variable} \end{array} \right]$$

### K map for 3 variable -

$$\text{no. of cells} = 2^3 = 8$$

$\backslash AB$	00	01	11	10
C				
0				
1				

Change only one bit at a time that's why order is 00, 01, 11, 10 not 00, 01, 10, 11



K map for 4 variable-

$$\text{no of cells} = 2^4 = 16$$

CD \ AB	00	01	11	10
00				
01				
11				
10				

K map rules for ~~xxx~~ simplifications:- (SOP)

1. Groups may not contain zero.
2. We can group 1, 2, 4, 8 or  $2^n$  cells.
3. Each group should be as large as possible.
4. Cells containing 1 must expression.  
(For each product term put 1 corresponding place in k map)
5. Groups may overlap.
6. Opposite grouping and corner grouping is allowing.
7. There should be as few groups as possible.

~~Zero~~ Complement zero is not considered in kmap, only 1 is consider.



## K map rules for POS Simplifications:-

1. Groups may not contain one.
2. We can group  $1, 2, 4, 8, \dots, 2^n$  cells.
3. Each group should be as large as possible.
4. Cell must contain 0 for each summed ~~product~~ term or numbers.
5. Group may overlap.
6. Opposite grouping and corners grouping is allowing.
7. There should be a few groups as possible.

**NOTE:-** In case of SOP for each number or product term we use 1 in place of that in K-map.

In case of POS for each sum term or number we use 0 in place of that in K-map.



Ex. -

$$f(A, B, C, D) = \bar{A}BCD + \bar{A}\bar{B}CD$$

→ It is in SOP. So,

and  $\bar{A}BCD \Rightarrow 0111$  (for SOP  $A \rightarrow 1$   
 $\bar{A} \rightarrow 0$ )

$$\bar{A}\bar{B}CD \Rightarrow 0011$$

which we can show in K-map as:

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

for 0011

for 0111

NOTE:- After grouping if group is in one row or column

• if it is in one row, multiple columns find common digit in column that will be final and after merging with row

• if it is in one column, multiple rows find common in all row that will be final and after merging with column.



AD \ BC	00	01	11	10
00		1	1	
01	1	1	1	1
11			1	
10		1		

$$(\bar{A}\bar{D}C + \bar{A}DC) + \bar{A}D + BC$$

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

⑩

NOTE: - In one group find common digit or numbers in row part and column part.