



# **SNS COLLEGE OF TECHNOLOGY**

**Coimbatore-35**  
**An Autonomous Institution**



Accredited by NBA – AICTE and Accredited by NAAC – UGC with 'A++' Grade  
Approved by AICTE, New Delhi & Affiliated to Anna University, Chennai

## **DEPARTMENT OF ELECTRONICS & COMMUNICATION ENGINEERING**

### **19ECB231 – DIGITAL ELECTRONICS**

II YEAR/ III SEMESTER

UNIT 1 – MINIMIZATION TECHNIQUES AND LOGIC GATES

TOPIC - KARNAUGH MAP MINIMIZATION ,DON'T CARE CONDITIONS- Problems



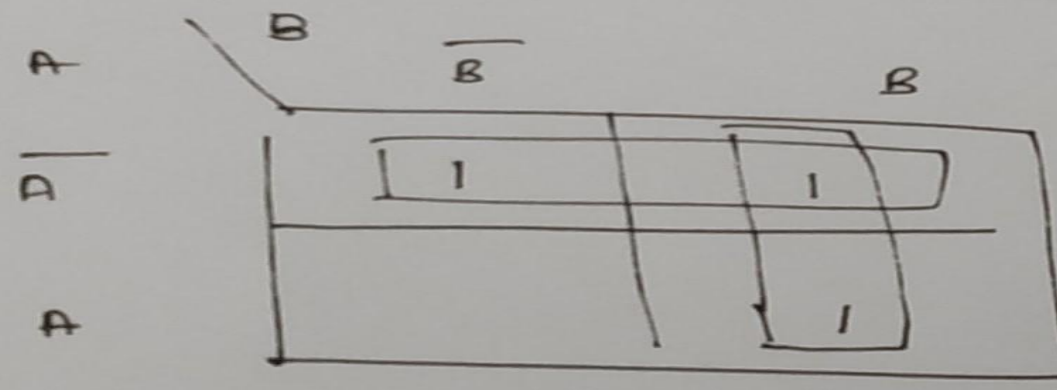
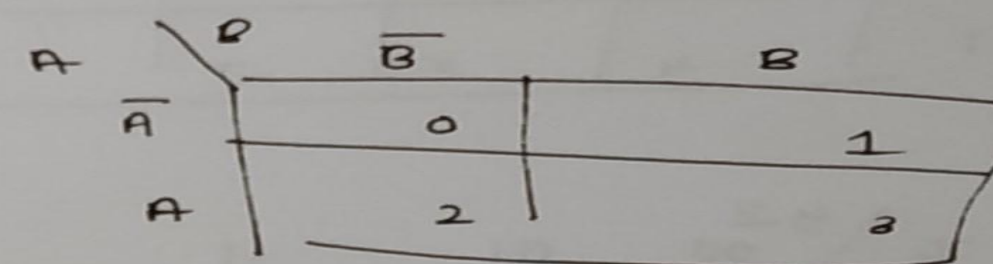
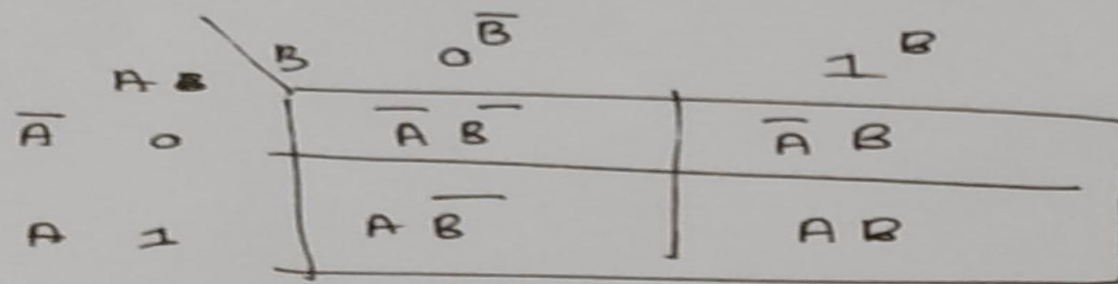
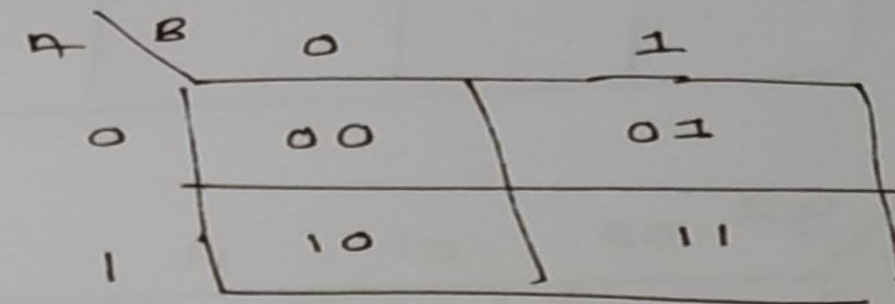
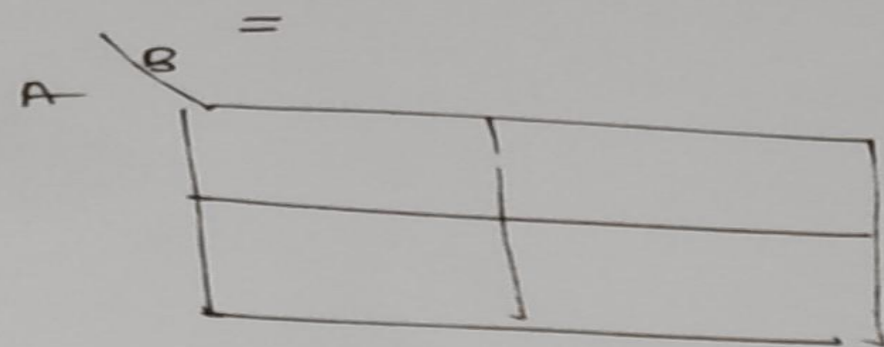
### Two variable k-map

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

$n$  = number of variables

$$n = 2.$$

$$\text{No of columns in k-map} = 2^n = 2^2 = 4$$



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



Three variable k-map.

$$F(x, y, z) = \sum (2, 3, 4, 5)$$

$$n = 3$$

$$\text{No. of columns} = 2^2 = 4$$

		yz	00	01	11	10
x	0					
	1					

		yz	00	01	11	10
x	0		0	1	2	3
	1		4	5	7	6

		yz	00	01	11	10
x	0				1	1
	1		1	1		

Annotations:  $\overline{xy}$  points to the top-right group of 1s;  $x\overline{y}$  points to the bottom-left group of 1s.

so

$$f(x, y, z) = \sum (2, 3, 4, 5) = \overline{xy} + x\overline{y}$$





3. Minimize the following standard pos expression using k-map.

$$Y = \prod M(0, 2, 3, 5, 7)$$

Sol:-  
 $n = 3, 2^3 = 8$

x	yz	00	01	11	10
0		0	1	3	2
1		4	5	7	6

x	yz	00	01	11	10
0		0	1	3	2
1		4	5	7	6

Group 1

x	yz	yz	y $\bar{z}$	$\bar{y}z$	$\bar{y}\bar{z}$
0		0	1	3	2
1		4	5	7	6

Group 2

x	yz	yz	y $\bar{z}$	$\bar{y}z$	$\bar{y}\bar{z}$
0		0	1	3	2
1		4	5	7	6

Group 3

$$Y = (x + z) \cdot (\bar{y} + \bar{z}) \cdot (\bar{x} + \bar{z})$$



# KARNAUGH MAP



4. Simplify the expression  $Y = \sum m(7, 9, 10, 11, 12, 13, 14, 15)$ , using the K-map method.

The handwritten solution shows the following steps:

**Step 1: Truth Table**

AB \ CD	00	01	11	10
00	0	1	3	2
01	4	5	7	6
11	1	1	1	1
10	1	1	1	1

**Step 2: K-map 1 (Grouping 1)**

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

Grouping 1: A horizontal group of four 1s in the row AB=11, circled as ①.

**Step 3: K-map 2 (Grouping 2)**

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

Grouping 2: A vertical group of four 1s in the column CD=11, circled as ②.

**Step 4: K-map 3 (Grouping 3)**

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

Grouping 3: A horizontal group of four 1s in the row AB=10, circled as ③.

**Step 5: K-map 4 (Grouping 4)**

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

Grouping 4: A vertical group of four 1s in the column CD=10, circled as ④.

**Final Simplified Expression:**

$$Y = AB + AC + AD + BCD$$





## KARNAUGH MAP - Simplifications

5. Plot the logical expression  $ABCD+AB'C'D'+AB'C+AB$  on a 4 variable K- map and obtain the simplified expression from the K- map.

The handwritten solution shows the following steps:

**Step 1: Truth Table**

AB \ CD	00	01	11	10
00	0	1	2	3
01	4	5	7	6
11	12	13	15	14
10	8	9	11	10

**Step 2: Plotting 1s**

The 1s are plotted in the following cells: (0,1), (0,2), (1,0), (1,1), (1,3), (1,4), (2,0), (2,1), (2,2), (2,3), (2,4), (3,0), (3,1), (3,2), (3,3), (3,4).

**Step 3: Grouping**

Three groups are identified:

- Group 1: A horizontal group of 4 cells in the top row (CD=01, 11, 10) and the bottom row (CD=01, 11, 10). This group is labeled 'AB'.
- Group 2: A vertical group of 4 cells in the first column (AB=01, 11, 10). This group is labeled 'AC'.
- Group 3: A vertical group of 4 cells in the last column (AB=01, 11, 10). This group is labeled 'AD'.

**Step 4: Simplified Expression**

$$Y = AB + AC + AD$$



## Don't Care Conditions

- Don't Care conditions allow us to replace the empty cell of a K-Map to form a grouping of the variables.
- While forming groups of cells, we can consider a “Don't Care” cell as either 1 or 0 or we can simply ignore that cell.
- Don't Care condition can help us to form a larger group of cells.



# Don't Care Conditions

Don't Care Conditions:-  
It is represented as 'X' may be assumed to be 0 or 1 as per the requirement for simplification.

Problem:-  
Simplify the Boolean expression using K-map.

$$Y = \sum m(1, 3, 7, 11, 15) + d(0, 2, 5)$$

|  
minterms

↳ don't care

AB \ CD	00	01	11	10
00	X	1	1	X
01	4	X	1	6
11	12	13	1	14
10	8	9	1	10

don't care treated as '1'

simplified expression is,  
 $Y = CD + \overline{A}B$





**THANK YOU**