



# **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**

### **23ECB221 – DIGITAL ELECTRONICS**

II YEAR/ III SEMESTER

#### **UNIT 1 – MINIMIZATION TECHNIQUES AND LOGIC GATES**

#### **TOPIC 6 - KARNAUGH MAP MINIMIZATION ,DON'T CARE CONDITIONS- Problems**



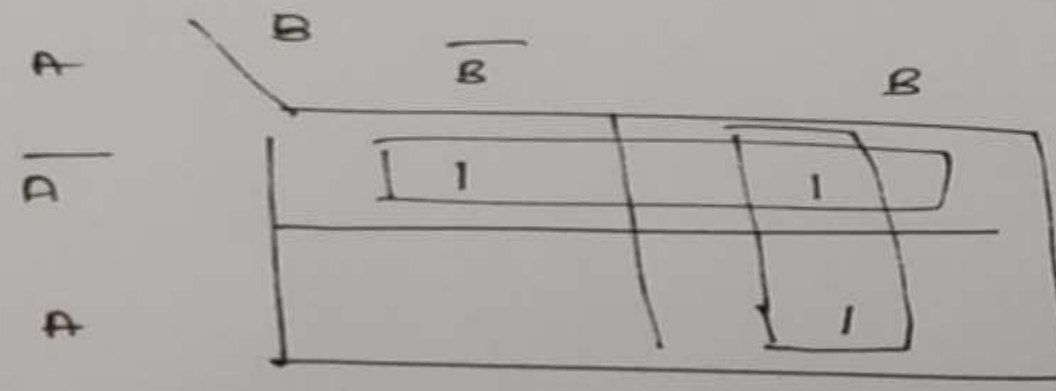
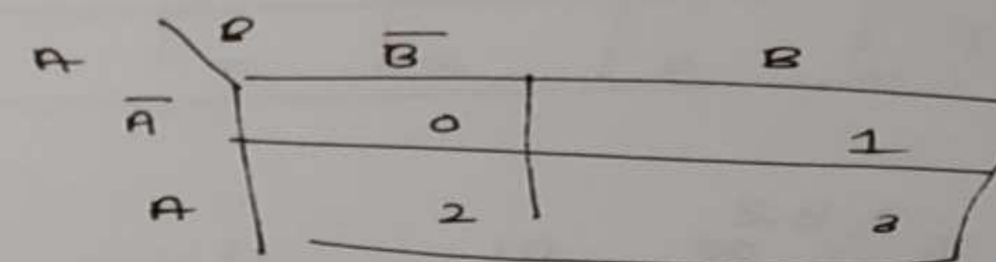
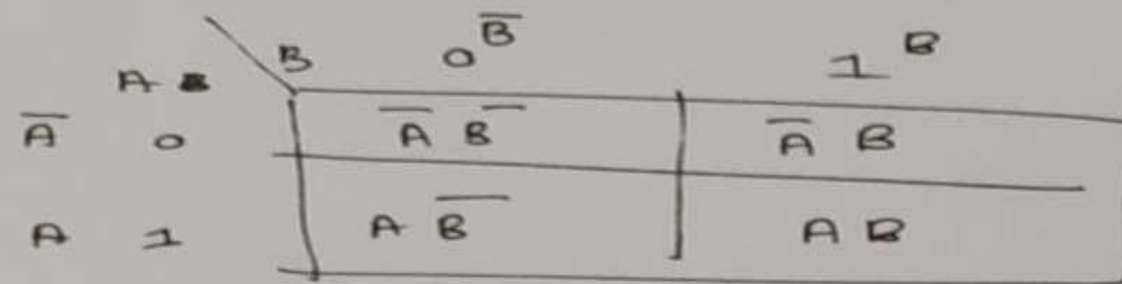
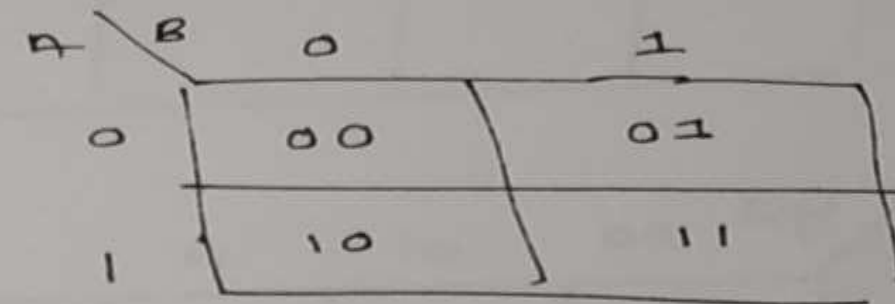
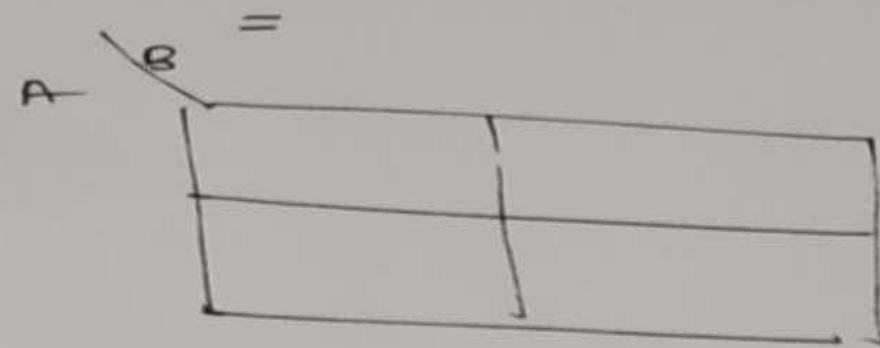
### Two variable k-map

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

$n$  = 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.

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

$$n = 3$$

$$\text{No. of columns} = 2^n = 8$$

		yz	00	01	11	10
x	0					
	1					

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

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

$\overline{x}y$  (pointing to the top-right group of 1s)

$x\overline{y}$  (pointing to the bottom-left group of 1s)

so

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



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		0	0
1			0	0	

Group 1

x	yz	yz	y $\bar{z}$	$\bar{y}z$	$\bar{y}\bar{z}$
x	0	0		0	0
$\bar{x}$	1		0	0	

Group 2

x	yz	yz	y $\bar{z}$	$\bar{y}z$	$\bar{y}\bar{z}$
x	0	0		0	0
$\bar{x}$	1		0	0	

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	8	9	11	10

**Step 2: K-map Groupings**

The K-map is filled with 1s in the following cells: (0,1), (0,3), (1,1), (1,3), (1,4), (1,5), (1,7), (1,6), (2,0), (2,1), (2,3), (2,2), (3,0), (3,1), (3,3), (3,2).

Groupings are shown as follows:

- Group 1: A horizontal group of four 1s in the row AB=11, covering cells (1,0), (1,1), (1,3), (1,2). This group is labeled with a circled 1.
- Group 2: A vertical group of four 1s in the column CD=01, covering cells (0,1), (1,1), (2,1), (3,1). This group is labeled with a circled 2.
- Group 3: A vertical group of four 1s in the column CD=11, covering cells (0,3), (1,3), (2,3), (3,3). This group is labeled with a circled 3.
- Group 4: A horizontal group of four 1s in the row AB=10, covering cells (2,0), (2,1), (2,3), (2,2). This group is labeled with a circled 4.

**Step 3: 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:

- Initial Map:** A 4x4 Karnaugh map with rows labeled AB (00, 01, 11, 10) and columns labeled CD (00, 01, 11, 10). The 1s are placed at (00,00), (00,01), (00,11), (00,10), (01,00), (01,01), (01,11), (01,10), (11,00), (11,01), (11,11), (11,10), (10,00), (10,01), (10,11), and (10,10).
- Grouping:** Three groups are identified:
  - Group 1: A horizontal group of 1s in the first row (AB=00), labeled ① AB.
  - Group 2: A horizontal group of 1s in the third row (AB=11), labeled ② AC.
  - Group 3: A vertical group of 1s in the first column (CD=00), labeled ③ AD.
- 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 or 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	15

don't care treated as '1'

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





# Assessment



1. What is Don't care conditions in k-MAP?
2. What are the objectives of K-Map Minimization Techniques?
3. Draw three variable K-Map .



**THANK YOU**