



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



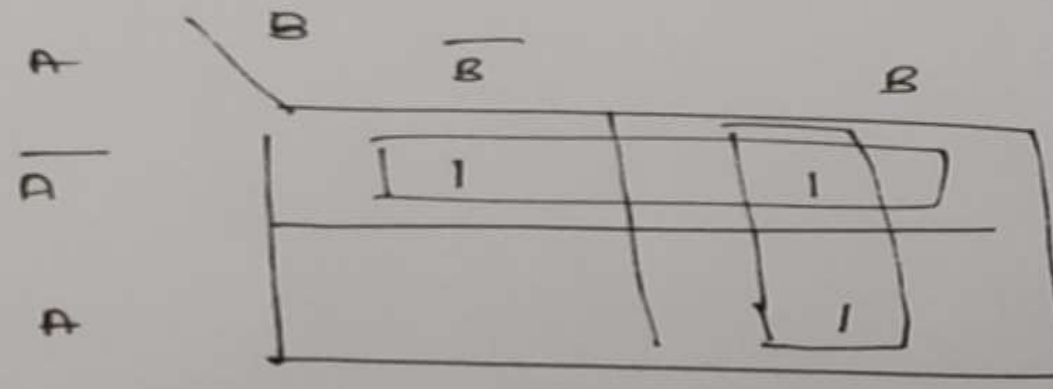
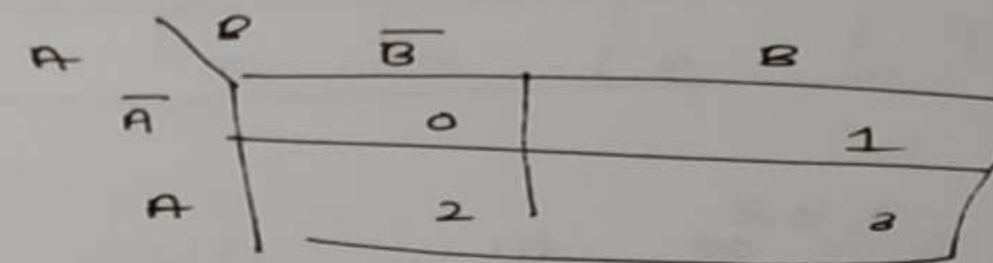
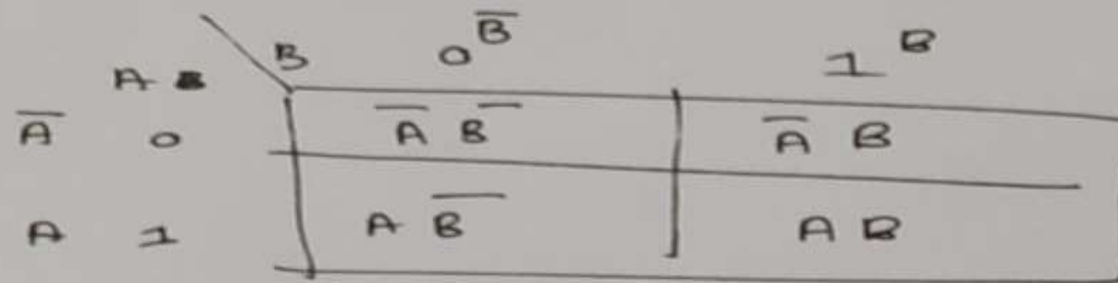
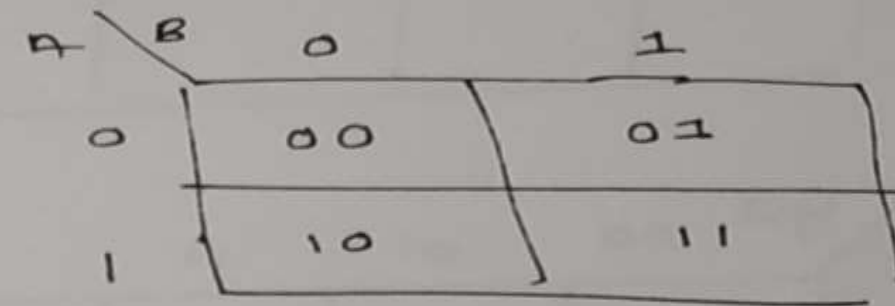
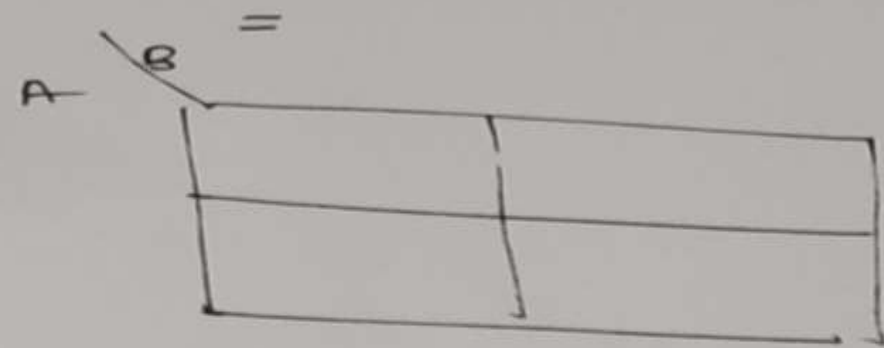
Two variable k-map

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

n = number of variables

$n = 2$

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	2
	1		4	5	7	6

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

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

so

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



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

Group 2

x	yz	00	01	11	10
x	0	0		0	0
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:

1. A 4x4 Karnaugh map for variables A, B, C, and D. The rows are labeled AB (00, 01, 11, 10) and the columns are labeled CD (00, 01, 11, 10). The map contains 1s in the following cells: (01, 01), (01, 11), (01, 10), (11, 00), (11, 01), (11, 11), (11, 10), (10, 01), (10, 11), (10, 10).

2. A K-map with a single horizontal group of four 1s in the row AB=01, circled as group 1. This represents the term $\overline{A}B$.

3. A K-map with a single horizontal group of four 1s in the row AB=11, circled as group 2. This represents the term AB .

4. A K-map with a single vertical group of four 1s in the column CD=11, circled as group 3. This represents the term CD .

5. A K-map with a single vertical group of four 1s in the column CD=10, circled as group 4. This represents the term $C\overline{D}$.

6. The final simplified expression is written in a box: $Y = AB + AC + AD + BCD$.



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.

Handwritten Karnaugh map solution for the expression $ABCD + AB'C'D' + AB'C + AB$. The solution shows three 4x4 K-maps. The first map shows the original expression with 1s in cells (0,0), (0,1), (0,2), (0,3), (1,0), (1,1), (1,2), (1,3), (2,0), (2,1), (2,2), (2,3), (3,0), (3,1), (3,2), (3,3). The second map shows the same expression with groupings: a horizontal group of 4 cells (0,0)-(0,3) labeled '1', a horizontal group of 4 cells (1,0)-(1,3) labeled '1', a vertical group of 2 cells (0,0)-(1,0) labeled '1', and a vertical group of 2 cells (0,3)-(1,3) labeled '1'. The third map shows the same expression with groupings: a horizontal group of 4 cells (0,0)-(0,3) labeled '1', a horizontal group of 4 cells (1,0)-(1,3) labeled '1', a vertical group of 2 cells (0,0)-(1,0) labeled '1', and a vertical group of 2 cells (0,3)-(1,3) labeled '1'. The final simplified expression is $Y = AB + AC + AD$.



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



THANK YOU