



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



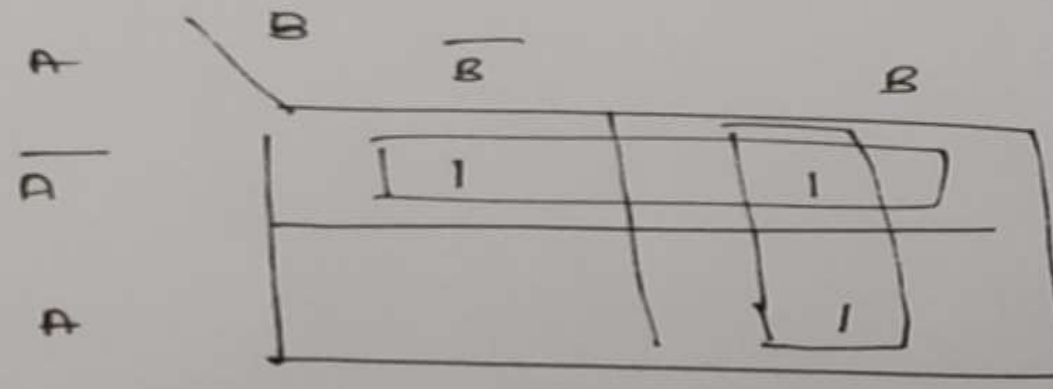
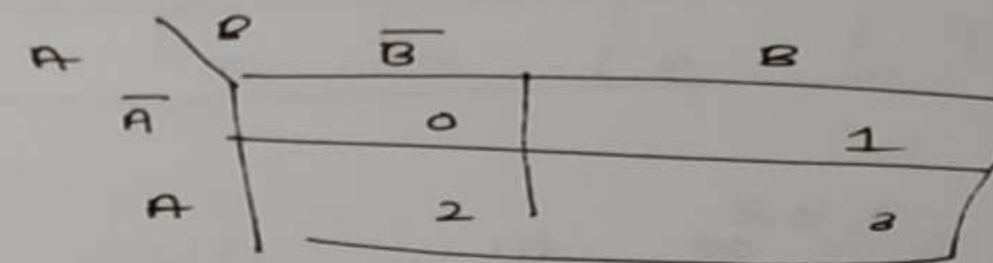
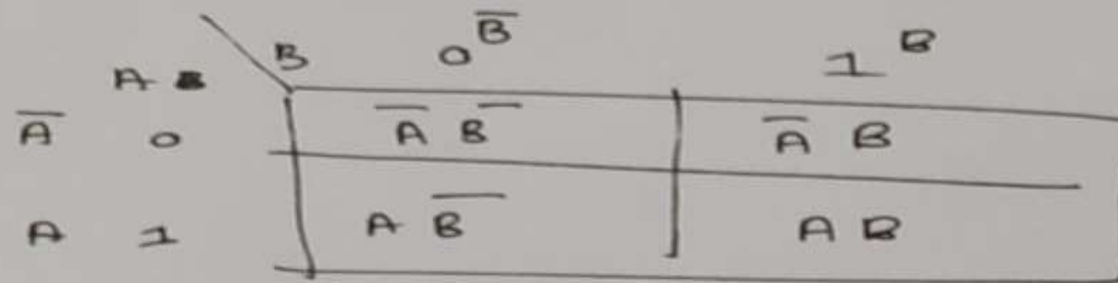
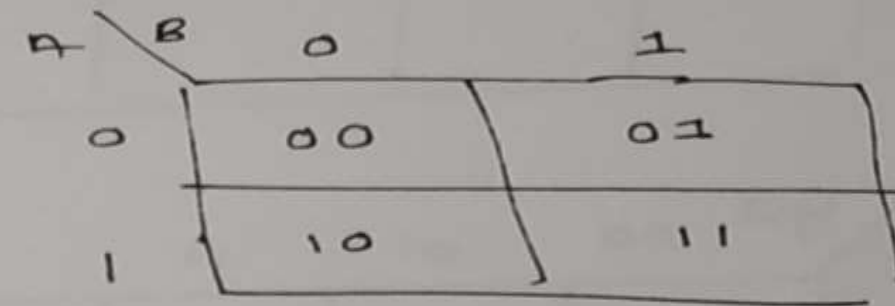
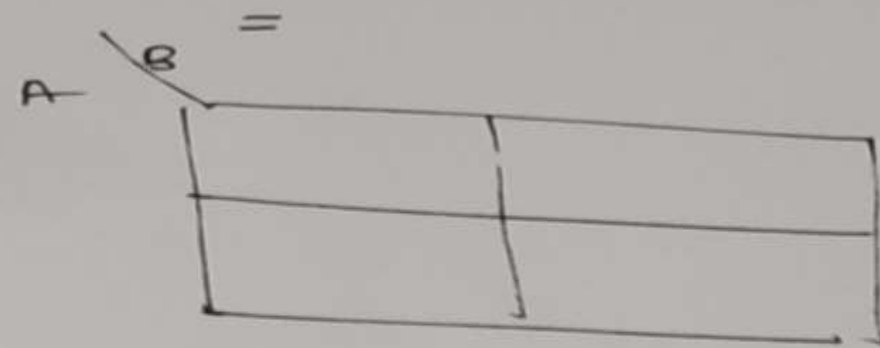
Two variable k-map

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

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	2
	1		4	5	7	6

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

so

\overline{xy} (pointing to the top row)

$x\overline{y}$ (pointing to the bottom row)

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



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	00	01	11	10
\bar{x}		0	1	3	2
x		4	5	7	6

Group 2

x	yz	00	01	11	10
\bar{x}		0	1	3	2
x		4	5	7	6

Group 3

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



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		12	13	15	14
10		8	9	11	10

Step 2: K-map 1 (Grouping 1)

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

Step 3: K-map 2 (Grouping 2)

AB	CD	00	01	11	10
00					
01					
11					
10					

Step 4: K-map 3 (Grouping 3)

AB	CD	00	01	11	10
00					
01					
11					
10					

Step 5: K-map 4 (Grouping 4)

AB	CD	00	01	11	10
00					
01					
11					
10					

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:

Map 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

Map 2: Plotting 1s

AB \ CD	00	01	11	10
00	0	1	1	1
01	0	1	1	1
11	1	1	1	1
10	1	1	1	1

Map 3: Simplification

AB \ CD	00	01	11	10
00	0	1	1	1
01	0	1	1	1
11	1	1	1	1
10	1	1	1	1

Three groups are circled and labeled:

- Group 1: AB (covers all 1s in the row where AB=11)
- Group 2: AC (covers all 1s in the column where C=1)
- Group 3: AD (covers all 1s in the column where D=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