Paper 7, TDC Part-3
Chapter– 4, Combinational Logic Design
Lecture - 5

By:

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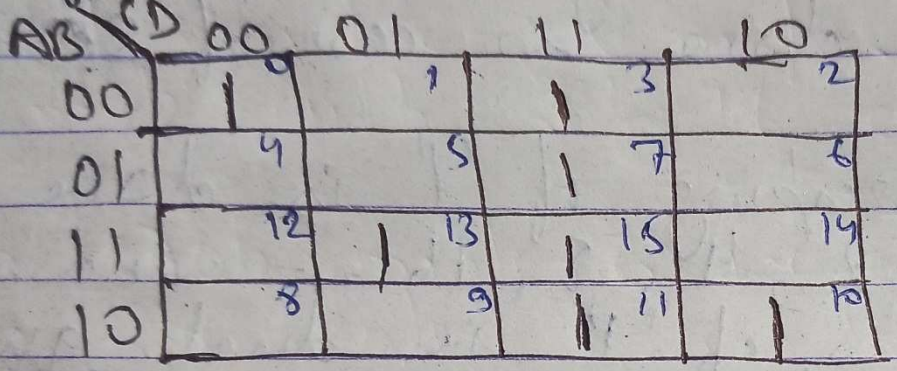
Example) Prepare the truth table for K-map. as shown below.



Sol. Since the K-map has 16 cells total i.e. $2^4 = 16$, this means the K-map is for a logical function with 4 variables.

The truth table for the logical function as per K-map is

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The truth table for the logical function as per K-map is

A	B	C	D	Y
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	0
1	0	0	1	0
1	0	1	0	1
1	0	1	1	1

Contd.

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Truth table continued

A	B	C	D	Y
1	1	0	0	0
1	1	0	1	1
1	1	1	0	0
1	1	1	1	1

The cell with no 1's, ~~to~~ corresponding to those cells '0' is placed in the truth table.

So if the K-map of a function is given then we can write the logical expression as well as the Truth table for the logical function.

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(i) Representation of Canonical SOP & POS Form on K-Map.

A logical function (equation) in canonical SOP form can be represented on a K-map by simply entering 1's in the cell corresponding to the each individual term present in logical equation.

Example 5.6) Represent eqn. below on K-map.

$$Y = \bar{A}B\bar{C}D + \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}\bar{C}\bar{D} + A\bar{B}C\bar{D} + AB\bar{D}C + A\bar{B}CD + AB\bar{C}\bar{D}$$

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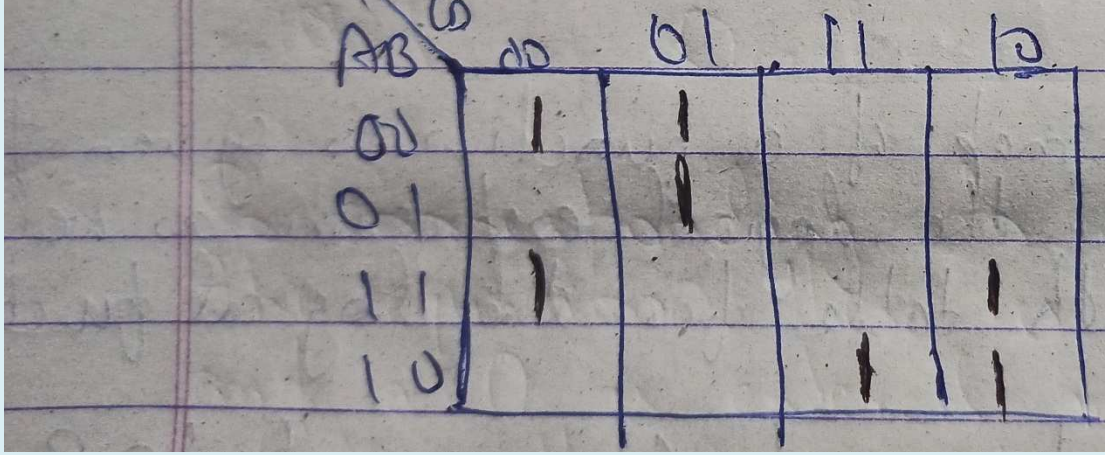
Sol. From the equation of the logic function Y, it clear that the function Y is a 4 variable K-map. So we draw a K-map with $2^4 = 16$ cells.

For each minterm ~~we write~~ present in eqn. we enter '1' in the corresponding cell as below



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Example 5.6) Write the logic equation in the cannonical SOP form for the K-Map shown below.

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

$$Y = \sum m(1, 3, 4, 6, 7, 9, 10, 11, 13)$$

$$Y = \bar{A}\bar{B}\bar{C}D + \bar{A}\bar{B}C\bar{D} + \bar{A}B\bar{C}\bar{D} + \bar{A}BC\bar{D} + \bar{A}BCD + A\bar{B}\bar{C}D + A\bar{B}C\bar{D}$$

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$+ \bar{A}\bar{B}CD + AB\bar{C}D.$

If the equation is in SOP form only, it should be converted to canonical SOP form, then represent the equation into the K-Map.

(ii) **Representation of Canonical POS form on K-map.**

Logic equation in canonical POS form can be represented on K-Map by entering 0's in the cells of K-Map corresponding to each maxterm of the equation.

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of the equation.

Example 5.7) Represent logic function X in K-map.

$$X = (\bar{A} + \bar{B} + C + D)(\bar{A} + B + \bar{C} + D)(\bar{A} + B + C + \bar{D})(A + \bar{B} + \bar{C} + \bar{D})(A + \bar{B} + C + D)(A + B + \bar{C} + \bar{D})(A + B + C + D)(A + \bar{B} + \bar{C} + D)$$

Sol:- As the function X is a function of 4 variable so the K-map with 16 cells

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is required to represent the function.

AB \ CD	00	01	11	10
00	$A+B+\bar{C}+D$ 0		$A+B+\bar{C}+\bar{D}$ 0	
01	$A+\bar{B}+C+D$ 0		$A+\bar{B}+\bar{C}+\bar{D}$ 0	$A+\bar{B}+\bar{C}+D$ 0
11	$\bar{A}+\bar{B}+C+D$ 0			
10		$\bar{A}+B+\bar{C}+\bar{D}$ 0		$\bar{A}+B+\bar{C}+D$ 0

So corresponding to each maxterm in the equation, there is a cell in the K-map and a 0 is entered in each one of these cells with those Maxterm. Here maxterm is written in each cell for better understanding.

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understanding.

If the logica function is not in canonical form then we have to convert the logic function into the canonical form 1st then only we can map the function into the K-map

So any function given in either SOP form or POS form it is required to convert the function into canonical SOP form or POS form respectively. Then the function can be mapped into K-map.

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Example: 5.8) Map the POS function

$$X(A,B,C) = (A+B+\bar{C})(A+\bar{C})(\bar{A}+\bar{B})$$

into the K-map.

Sol:- Since the given function X is a function of 3 variable so we need a K-map with 8 cells. Also the given function is not in canonical form so we will convert it into canonical form 1st.

$$X = (A+B+\bar{C})(A+\bar{C})(\bar{A}+\bar{B})$$

To convert into canonical form we will go as below.

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$$X = (A+B+\bar{C})(A+\bar{C}+B\bar{B})(\bar{A}+\bar{B}+C\bar{C})$$

$$X = (A+B+\bar{C})(A+\bar{C}+B)(A+\bar{B}+\bar{C})(\bar{A}+\bar{B}+\bar{C})(\bar{A}+\bar{B}+C)$$

$$X = (A+B+\bar{C})(A+\bar{B}+\bar{C})(\bar{A}+\bar{B}+C)(\bar{A}+\bar{B}+\bar{C})$$

K-Map for X is.

A \ BC	00	01	11	10
0	$A+B+C$	$A+B+\bar{C}$ ○	$A+\bar{B}+\bar{C}$ ○	$A+\bar{B}+C$
1	$\bar{A}+\bar{B}+\bar{C}$	$\bar{A}+B+\bar{C}$	$\bar{A}+\bar{B}+\bar{C}$ ○	$\bar{A}+\bar{B}+C$ ○

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→ From a given K-Map, we can write the logic equation in the canonical POS form by ANDing the maxterms corresponding to each 0 entry in the K-map.

→ If the equation is in POS form, it should be converted into canonical POS form and then it can be represented on K-map.

Example 5.9) Write the logic equation in the canonical POS form for the K-Map shown below.

A \ BC	00	01	11	10
0	0 (0)	0 (1)	0 (3)	(2)
1	0 (4)	(5)	0 (7)	0 (6)

Solution:

$$Y = \Pi M(1, 3, 4, 6, 7)$$
$$= (A + B + \bar{C})(A + \bar{B} + \bar{C})(\bar{A} + B + C)$$
$$(\bar{A} + \bar{B} + C)(\bar{A} + \bar{B} + \bar{C})$$

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Refer book- Modern Digital Electronics by RP Jain.

Thank You