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

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Grouping Four Adjacent Cells

Four adjacent cells can be grouped together if two of the literals associated with the "minterm/maxterm" are not same and the other literals are same.

In case of 2-variable map, there is only one possibility corresponding to entry 1/0 in all the four cells and the simplified expression will be Y = 1/0. That is Y always equals 1 for

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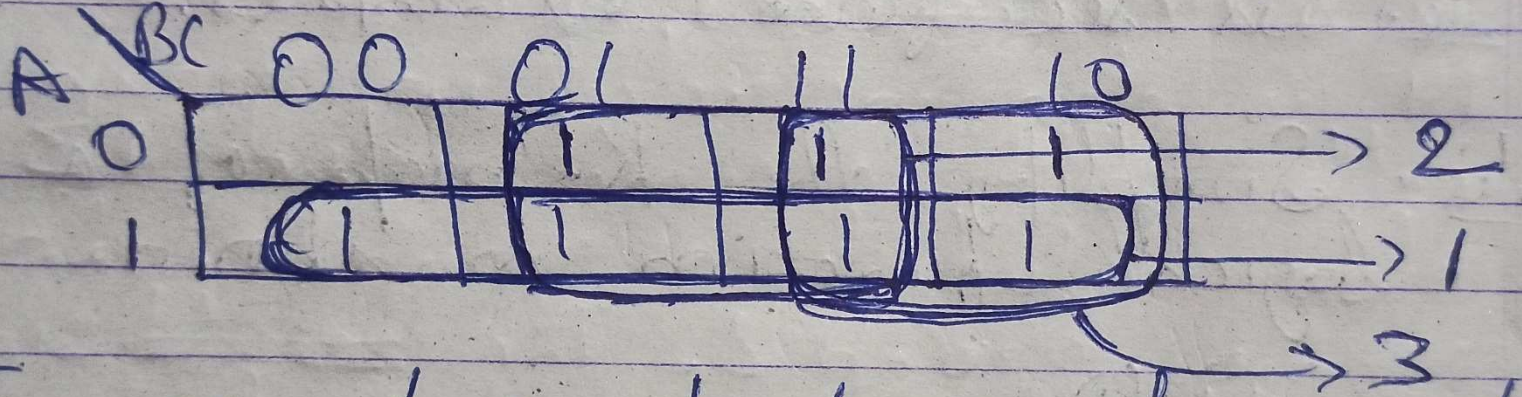
minterms or '0' for maxterms.

Figure below shows grouping of 4 cells in a 3-variable K-Map



In case of group 1 we have two literals B & C are not same, here only A is not changing.

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In case of group 2, we have two literals A & B are not same, here only C, is not changing.

And in case of group 3, we have two literal A & C are not same, here only B is not changing.

Table in next slide gives (list) all possible groups of four adjacent ones for each cell in a 3-variable map.

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ble 5.6 *Groups of Four Adjacent Ones in a 3-variable K-map*

Cell with decimal number	Decimal numbers of cells forming groups of adjacent fours		
0	(0, 2, 6, 4),	(0, 1, 2, 3),	(0, 1, 4, 5)
1	(1, 0, 2, 3),	(1, 3, 7, 5),	(1, 0, 4, 5)
2	(2, 0, 6, 4),	(2, 3, 1, 0),	(2, 3, 6, 7)
3	(3, 1, 7, 5),	(3, 2, 1, 0),	(3, 2, 6, 7)
4	(4, 6, 2, 0),	(4, 5, 6, 7),	(4, 5, 0, 1)
5	(5, 1, 3, 7),	(5, 4, 6, 7),	(5, 4, 0, 1)
6	(6, 0, 2, 4),	(6, 7, 4, 5),	(6, 7, 2, 3)
7	(7, 1, 3, 5),	(7, 6, 4, 5),	(7, 6, 2, 3)

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In the case of a 4-variable K-map, there are six possible groupings of 4-variables involving any cell.

Let us see few examples.

Example:- Simplify the K-map of a 4-variable logical function as shown below.

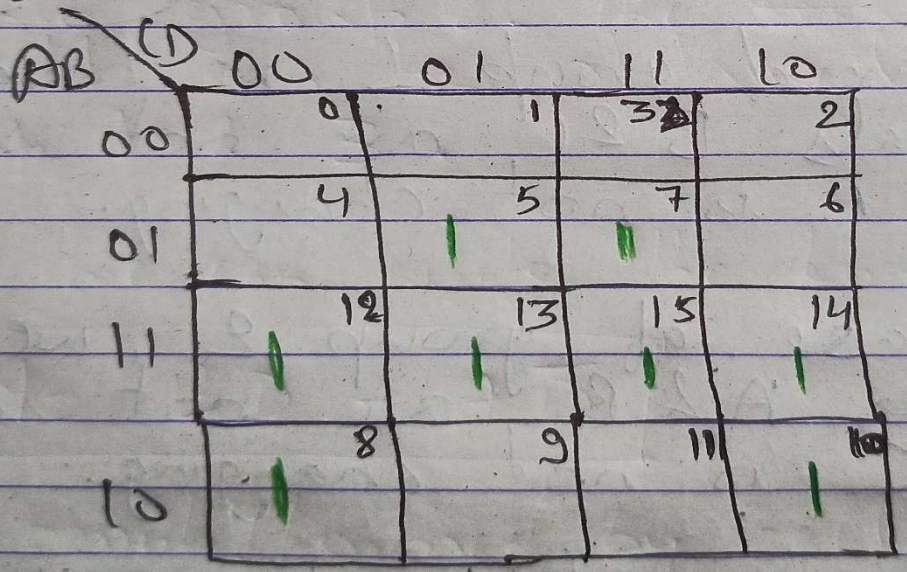

Fig -> 1(a)

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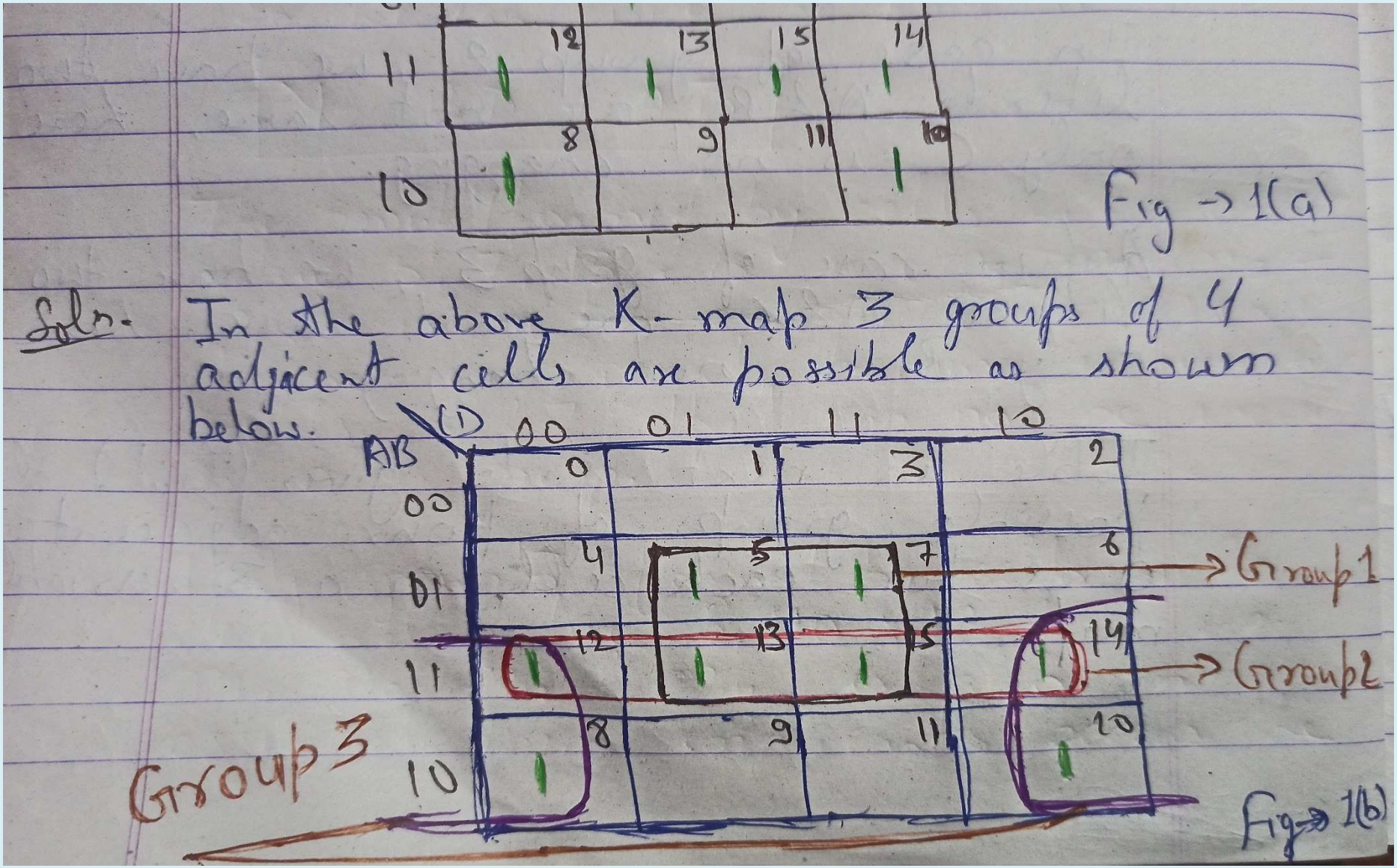

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Group 1 consists of adjacent cells with decimal value (5, 7, 13 & 15) and grouped using black ~~pen~~ ink

Group 2 consist of adjacent cells with decimal value (12, 13, 14 & 15) and grouped using red ~~pen~~ ink.

And group 3 consist of adjacent cells with decimal value (12, 8, 10 & 14) and grouped using purple ink.

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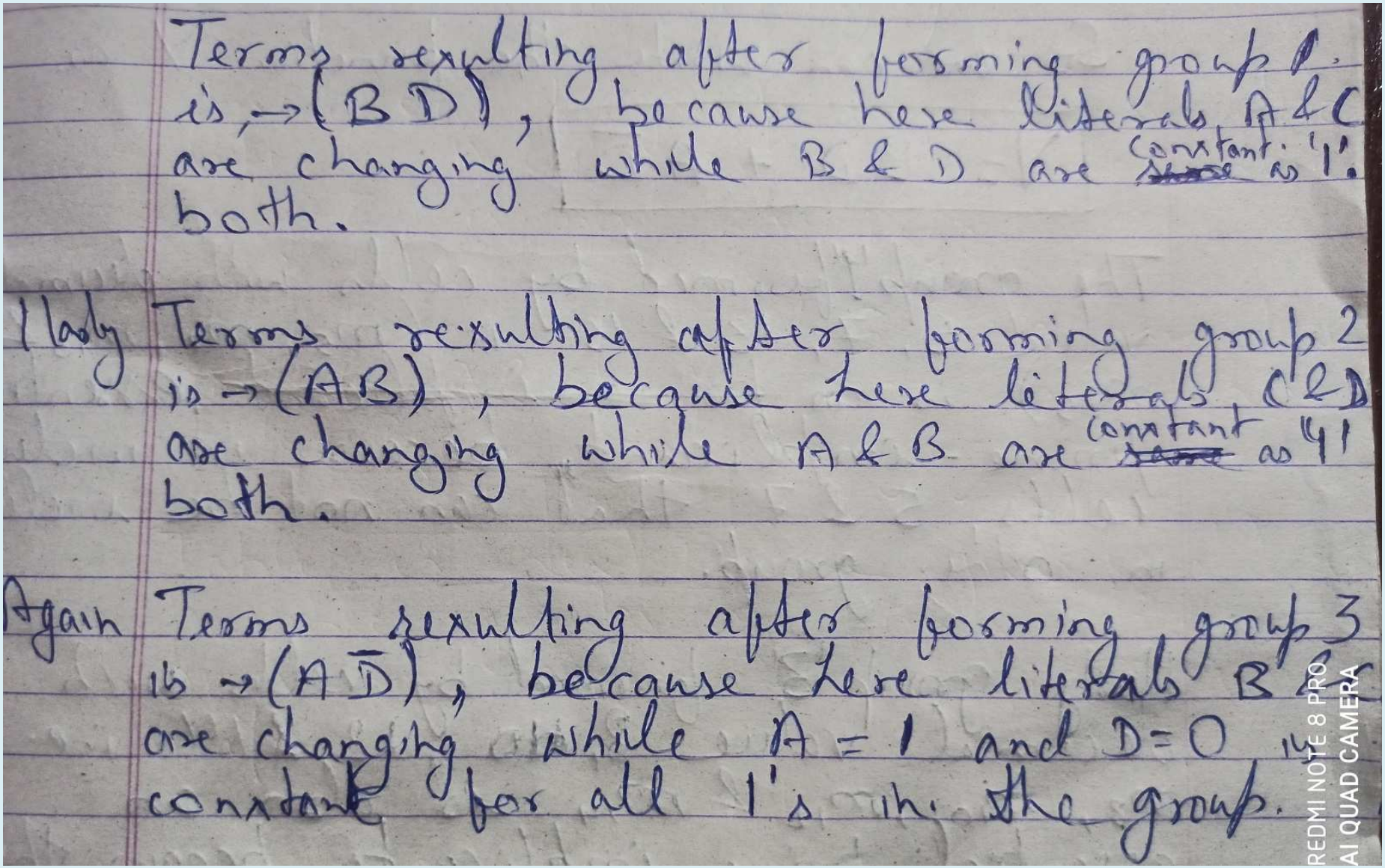

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In the K-map of figure 1(b) we can see that all 4-adjacent cells of Group 2 is included in Group 1 & 3.

~~12 & 14 decimal~~ Cells with decimal value 12 & 14 is also included in group 3 and cells with decimal value 13 & 15 is also included in group 1. So we will ignore group 2. The ~~result~~ simplified result can be obtained by taking group 1 & 3.

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So we can write the function Y as.

$$Y = BD + A\bar{D}$$

The group '4' formed by cells with decimal value 5, 7, 13 & 15 i.e. (m_5, m_7, m_{13} & m_{15}) is an ~~prime implicant~~ essential prime-implicant, because it include cells 5 & 7 that can not be included in other group.

Lastly group '3' formed by cells with decimal value 8, ~~10~~, 12 & 14 i.e. m_8, m_{10}, m_{12} & m_{14} is also an essential prime implicants because the

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cells 8 & 10 can't be included in other group.

While the group '2' formed by cells with decimal value (12, 13, 14 & 15 (i.e. m_{12}, m_{13}, m_{14} & m_{15} is a prime implicant because it's two cells 13 & 15 are included in group 1 and 12 & 14 are " " " 2, So group 2 is a not an essential prime implicants. It is only prime implicants.

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Refer book- Modern Digital Electronics by RP Jain.

Thank You