

Paper 7, TDC Part-3
Chapter– 4, Combinational Logic Design
Lecture - 9

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Minimisation of Logic Functions Specified in MINTERMS/MAX TERMS or TRUTH TABLE

A logic function in minimised form is referred to as a minimised expression, where the required number of gates reduces with a minimum number of inputs to the gates.

For minimising a logical function expressed in SOP form or given in a truth table, one has to prepare the K-map first and

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then combine the ones in such a way that the resulting expression is minimum.

Following algorithm can be used to minimize the ~~ex~~logical expression:

1. Identify the ones that can ^{not} be combined ~~is groups~~ with any other ones and encircle them. These are essential prime-implicants.
- 2.) Identify ~~and encircle~~ the ones that can be combined in groups of two in only one way and encircle such group of ones.

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- 3.) Identify the ones that can be combined with 3 other ones, to make a group of 4 adjacent ones, in only one way and encircle such group of ones.
- 4.) Identify the ones that can be combined with seven other ones, to make a group of eight adjacent ones in only one way. Encircle such group of ones.
- 5.) The ~~ones~~ groups identify in above steps 1 to 4 to form the groups of 2, 4 and 8 ones are the Essential Prime Implicant (EPI). If there still remains some ones which have not been encircled then these are

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To be combined with each other or with other already encircled ones.

We should combine the left-over ones in largest possible groups and in as few groupings as possible. In this, the groupings may not be unique and we should make the groupings in an optimum manner.

The logic function consisting of the EPs obtained in steps 1 to 4 and the prime implicants obtained in step 5 will be

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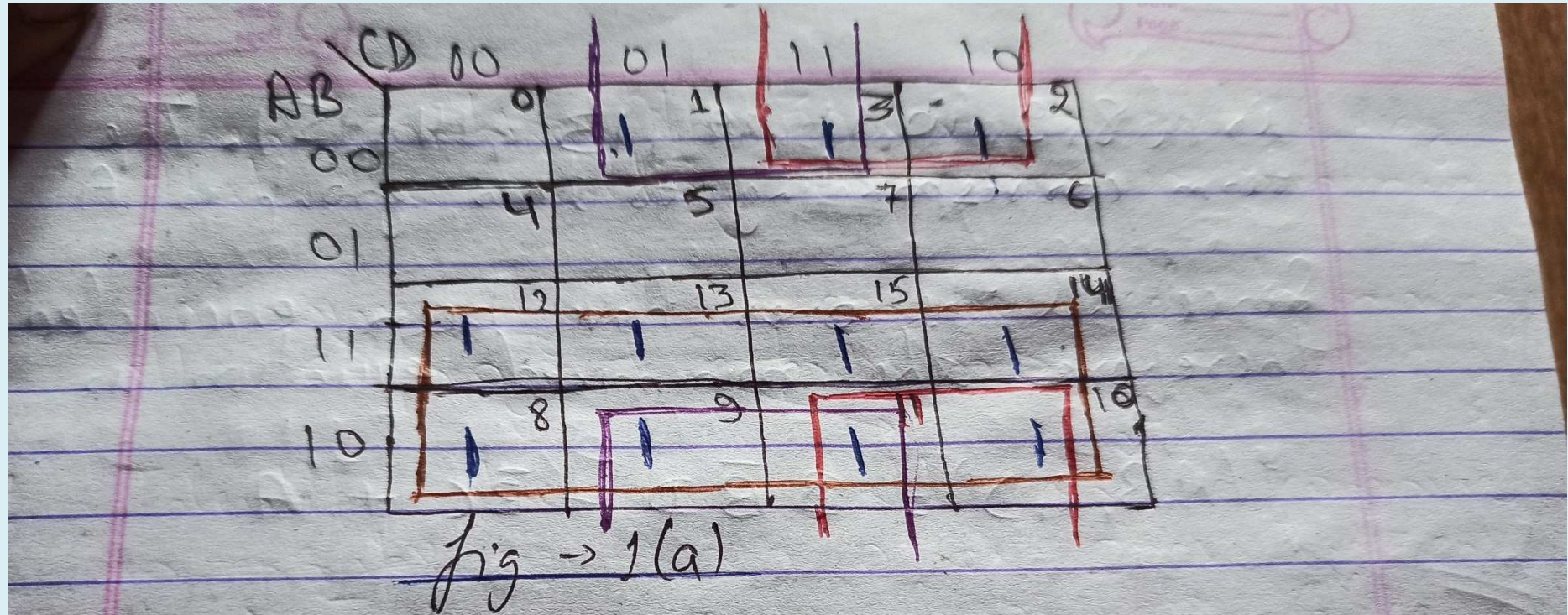
Let us look at few example to understand the minimisation using K-map.

Example 5) Minimise the 4-variable logic function using K-map.

$$f(A, B, C, D) = \sum m(1, 2, 3, 8, 9, 10, 11, 12, 13, 14, 15)$$

Soln: Let us map the ~~ab~~ given logic function in the K-map and form the group as per the procedure discussed. The K-map is shown in Fig 1(a).

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1. In the above K-Map there is no such ones which do not form the group, i.e. ~~size~~ ones without any adjacent ones.

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(2.) There are at least two possible ways for every 1 forming groups of two adjacent ones. Therefore we ignore it and go to the next step.

(3) There is only one possible group of 4 adjacent ones involving each of the cells '1' and '2' and these groups are (1, 3, 9, 11) and (2, 3, 10, 11) respectively. Encircle the groups. The term corresponding to these groups are $\overline{B}D$ and $\overline{B}C$ respectively.

(4) There is only one possible group of 8 adjacent ones involving each of the cells 12 or 13 or 15 or 14 or 8 or 9 or 11 or 10 and this group

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as (8, 9, 10, 11, 12, 13, 14, 15). The term corresponding to this group is 'A'.

Since all the ones have been encircled, therefore the minimised equation is

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

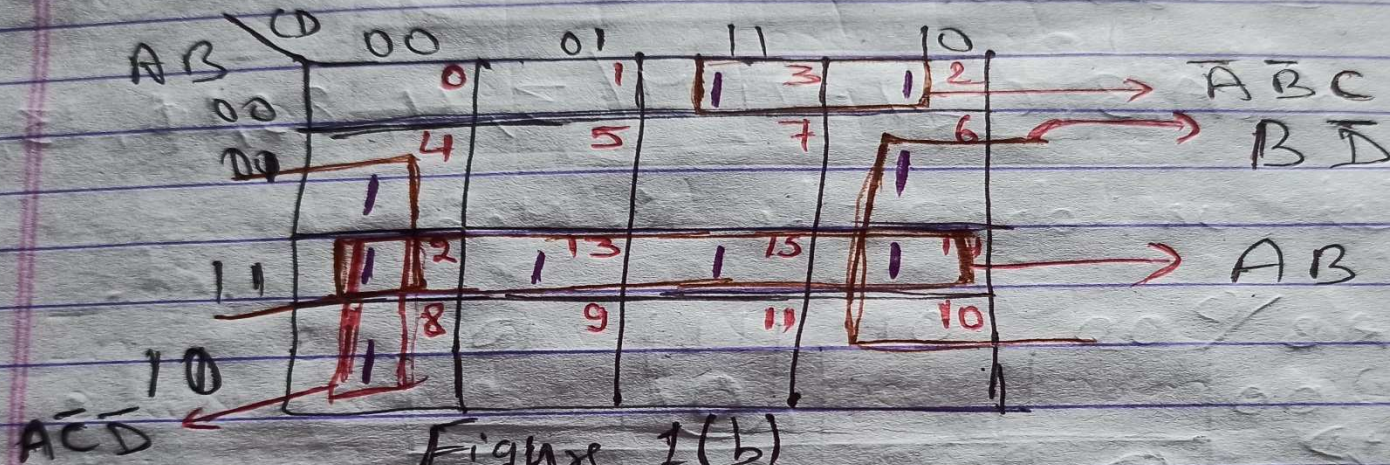
22) Determine the minimised expression in SOP form for the truth table given in Table 5.8.

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Inputs				Output
A	B	C	D	Y
0	0	0	0	0
0	0	0	1	0
0	0	1	0	1
0	0	1	1	1
0	1	0	0	1
0	1	0	1	0
0	1	1	0	1
0	1	1	1	0
1	0	0	0	1
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	1
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

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Soln:- Let us draw a 4-variable K-map first then map the truth table in the given K-map.



Using the steps described in the minimization procedure we will group the 1's as follows shown in K-Map of fig 1(b)

The minimised logic function is

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

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Refer book- Modern Digital Electronics by RP Jain.

Thank You