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

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Minimisation of Logic Functions Specified in MINTERMS/MAXTERMS or TRUTH TABLE

A logic function in minimised forms referred to minimised expression, where the required number of gates reduces with minimum number of inputs to the gate.

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 ~~exp~~logical expression:

1. Identify the ones that can not be combined ~~in 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 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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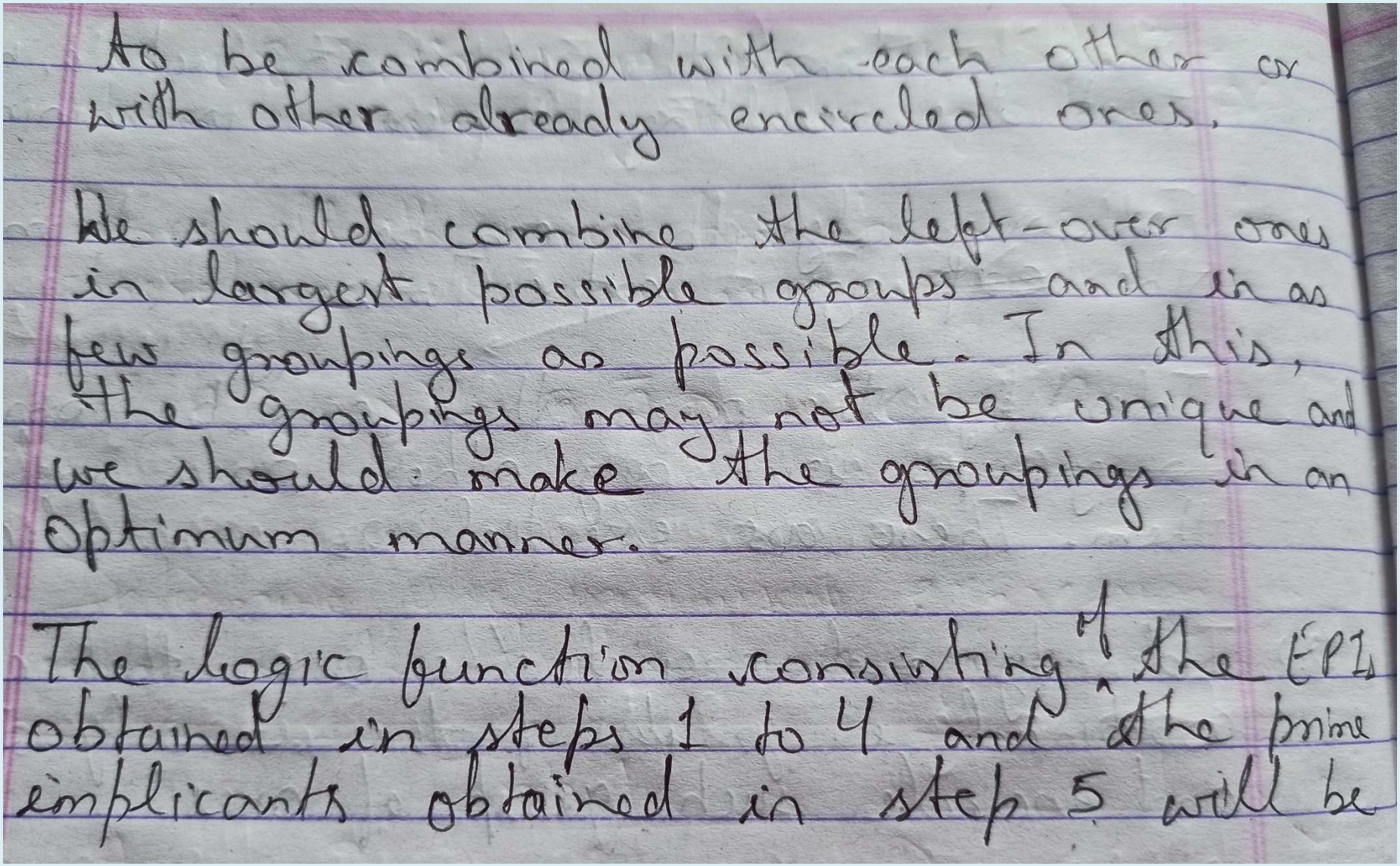

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Let us look at few example to understand the minimization using K-map.

Example 1) Minimise the 4-variable logic function using K-map.

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

Soln: Let us map the ~~abo~~ 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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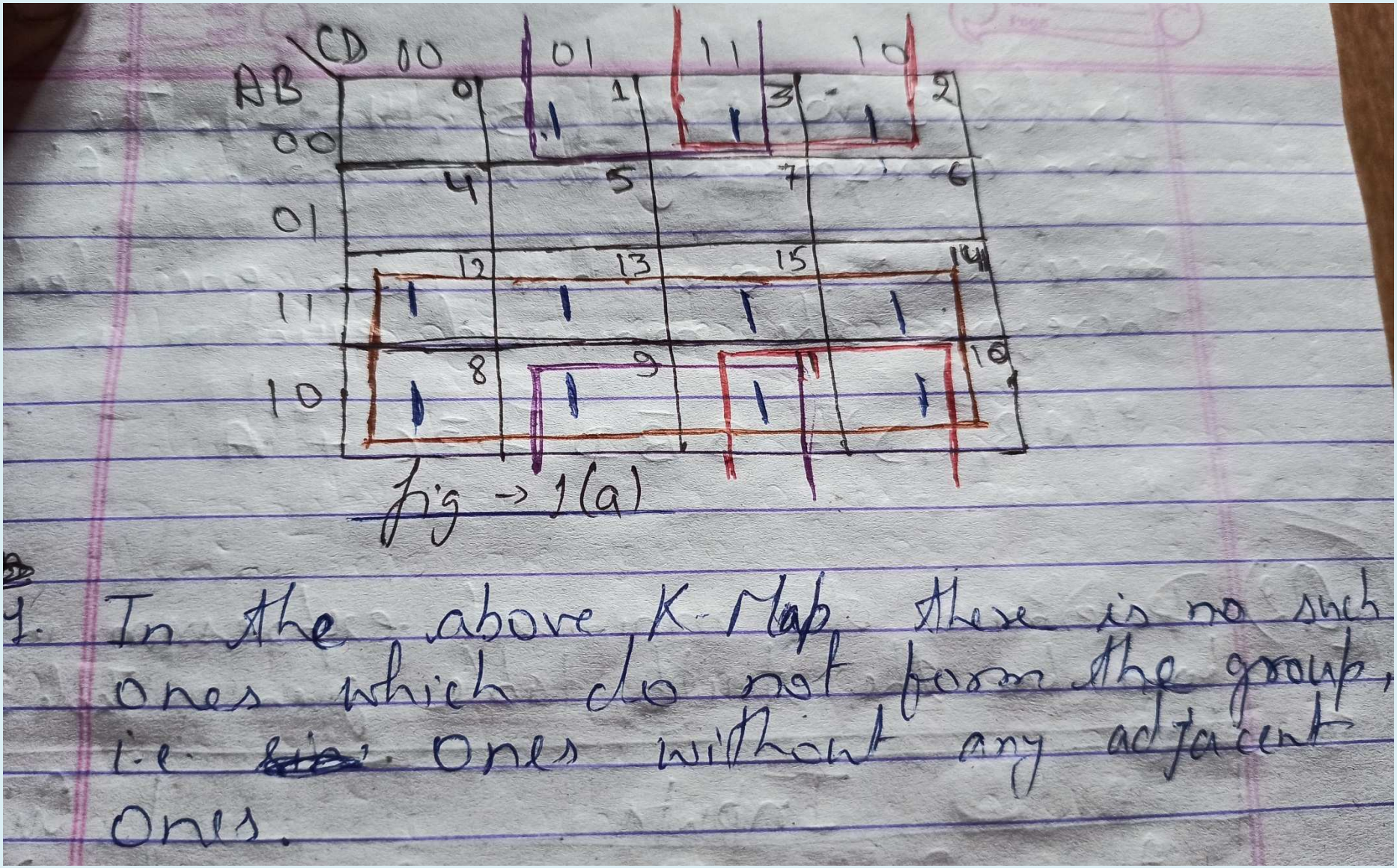

fig → 1(a)

1. In the above K-Map there is no such ones which do not form the group, i.e. 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 to these groups are $\bar{B}D$ and $\bar{B}C$ 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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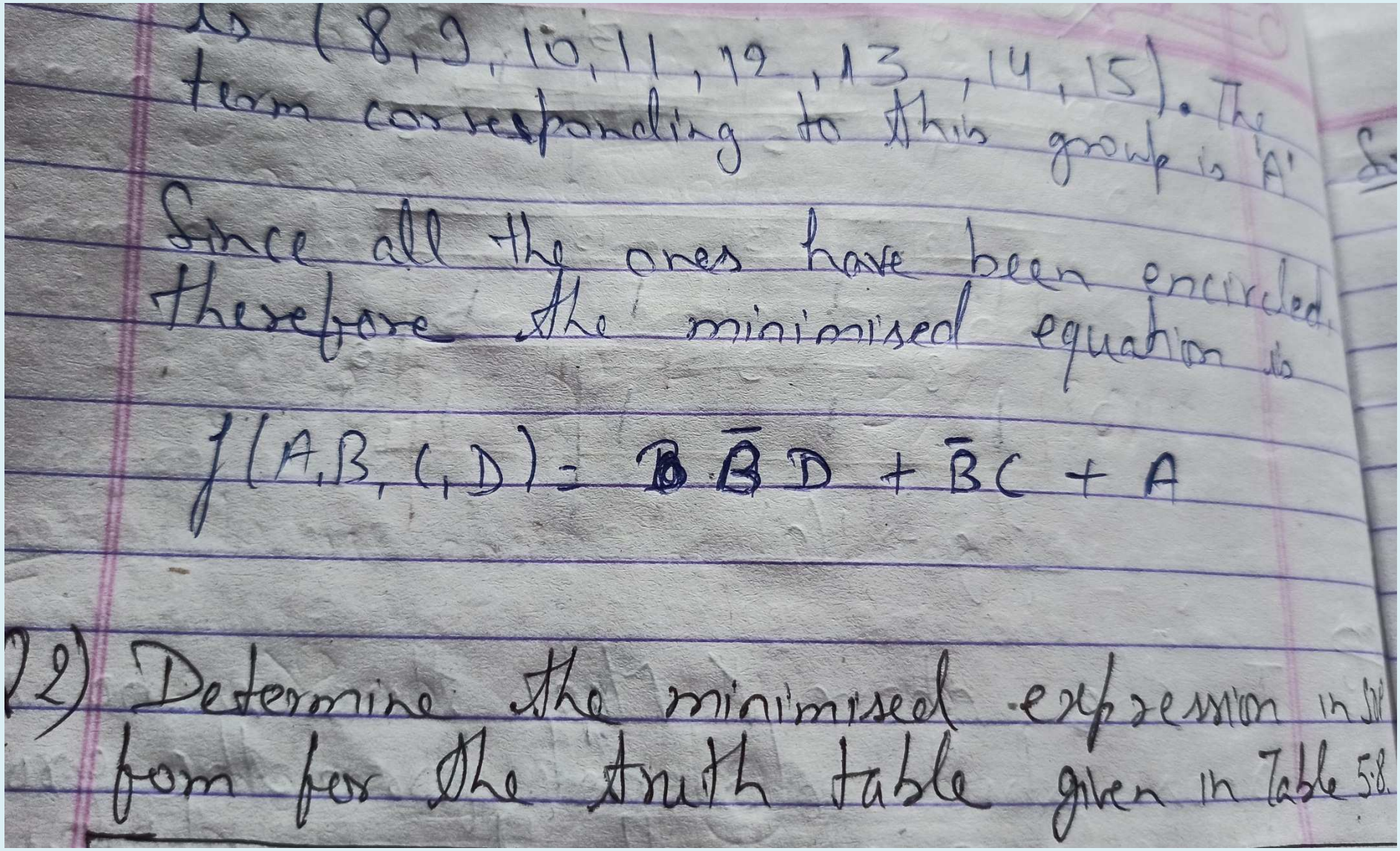

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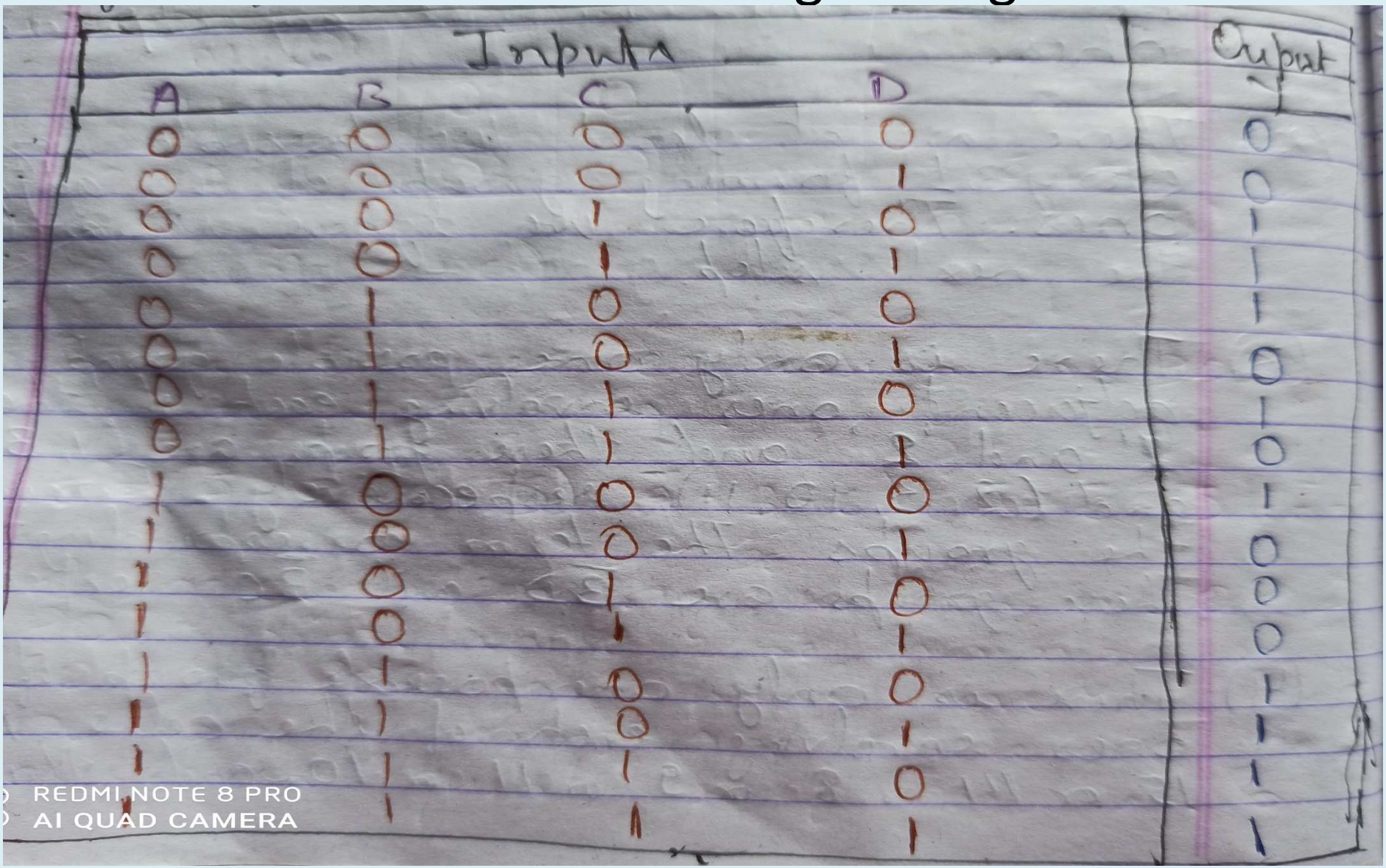

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Soln:- Let us draw a 4-variable K-map first then map the truth table in the given drawn K-map.

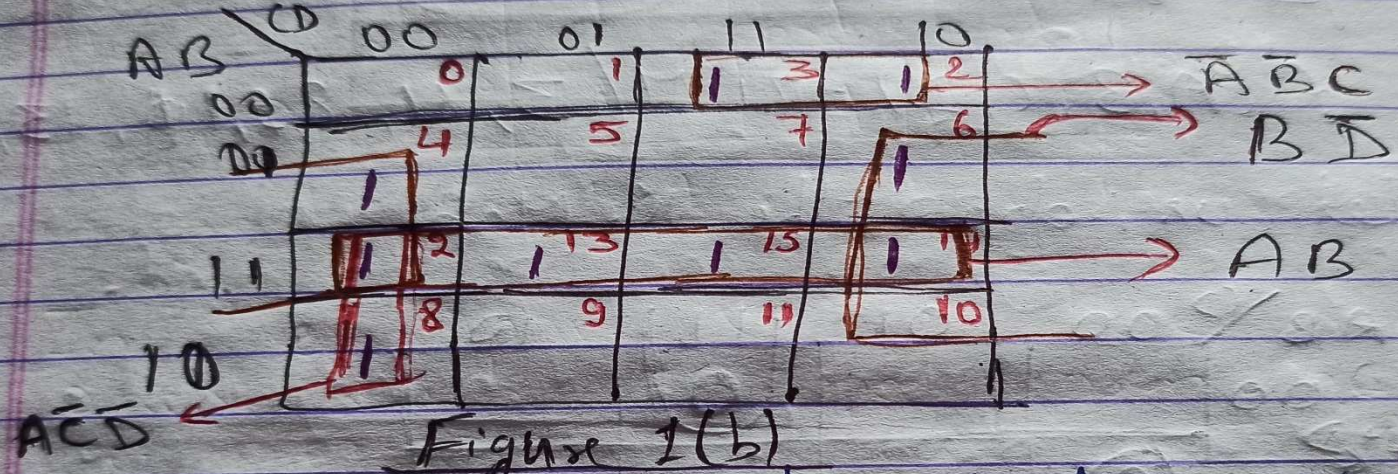

Figure 1(b)

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

The minimised logic function is

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

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Refer book- Modern Digital Electronics by RP Jain.

Thank You