Paper 7, TDC Part-3
Discussion of some questions of 2017
Lecture - 3

By:

Mayank Mausam

Assistant Professor (Guest Faculty)

Department of Electronics

L.S. College, BRA Bihar University,

Muzaffarpur, Bihar

Discussion of 2017 Questions

Q9) What is K-Map? Taking a suitable example, explain how it helps in minimization of a logic function. Discuss the formation of 5-variable K-map?

Sol:- K-map is a graphical technique that provides a systematic method for simplifying logic function (Boolean expressions) into simpler form. In this technique, the information contained in a truth table or in SOP or POS form is represented on a map called Karnaugh map (K-map)

K-map of a n-variable [illegible] will have 2^n no. cells

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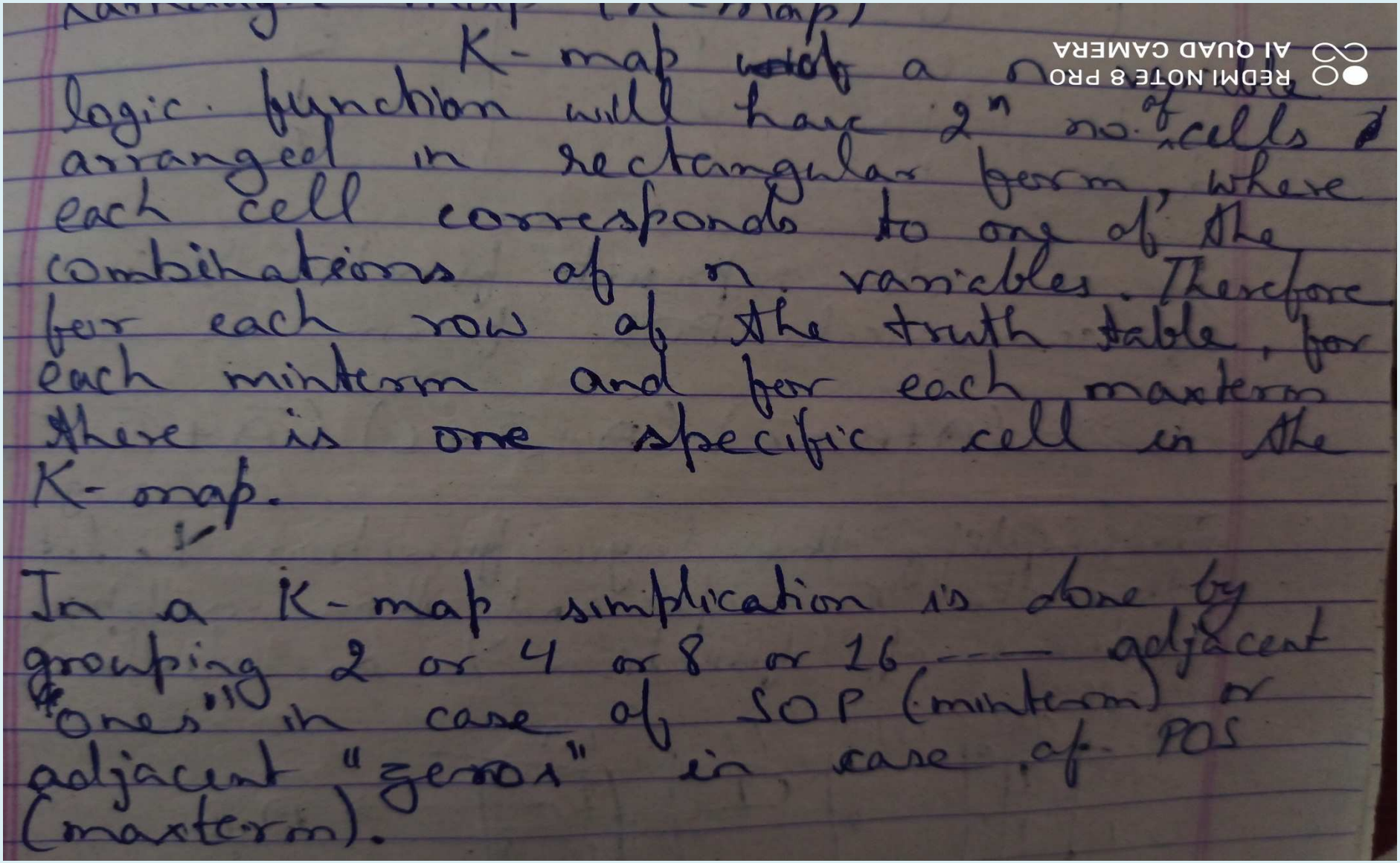

K-map with a n variable logic function will have 2^n no. of cells arranged in rectangular form, where each cell corresponds to one of the combinations of n variables. Therefore for each row of the truth table, for each minterm and for each maxterm there is one specific cell in the K-map.

In a K-map simplification is done by grouping 2 or 4 or 8 or 16 ---- adjacent "ones" in case of SOP (minterm) or adjacent "zeros" in case of POS (maxterm).

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For Example Consider a 3-variable logic function

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

The truth table of above logic function can be given as below.

A	B	C	Y (Output)
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

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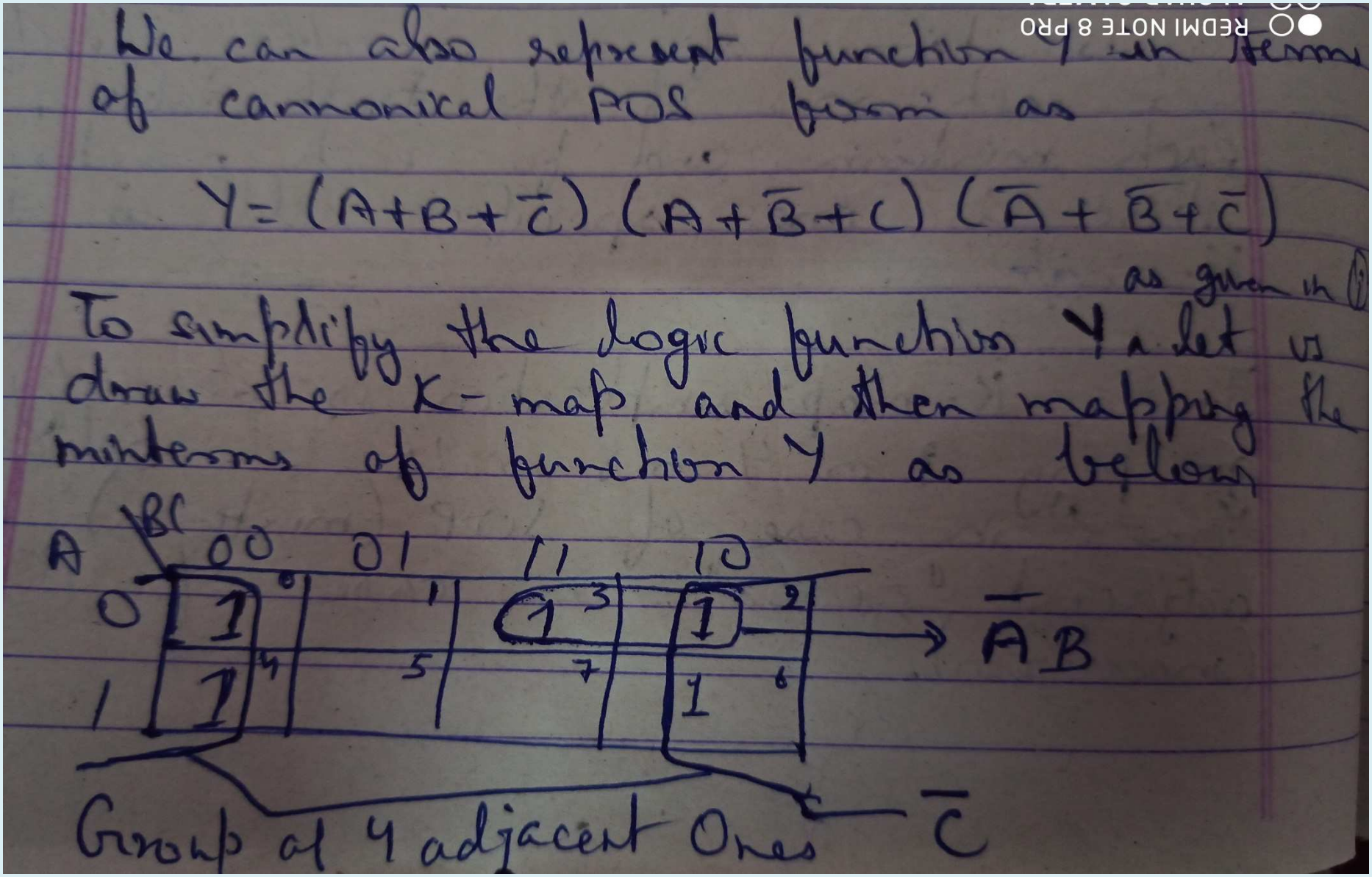
We can also represent function Y in terms of canonical POS form as

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

To simplify the logic function Y as given in (i), let us draw the K-map and then mapping the minterms of function Y as below



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Here we can form a group of 4 adjacent 1's by grouping cells (0, 2, 4 & 6) as shown in map.

Then the term corresponding to this group is — $\bar{C}$

One more group of 2 adjacent 1's also possible with cells (2 & 3), the term corresponding to this group is $\bar{A}B$

So the simplified logic function is given as

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

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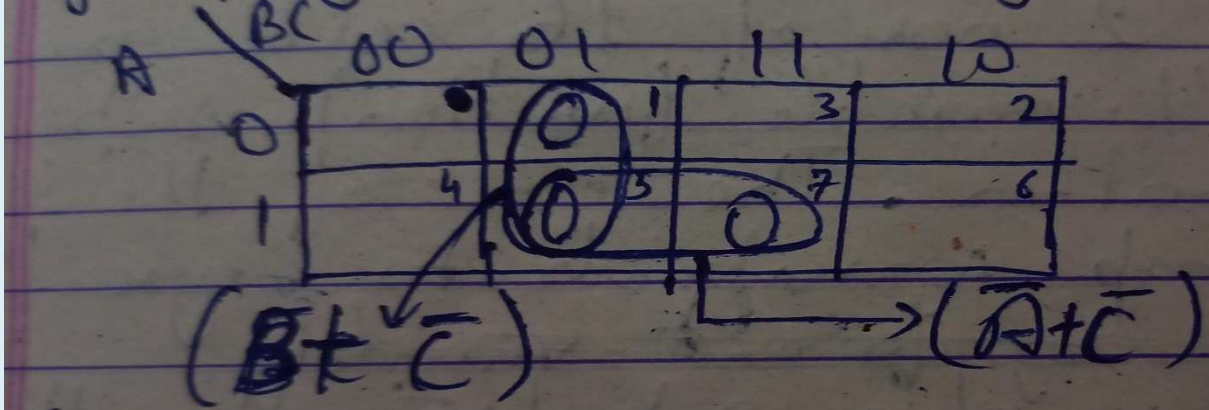
We can also solve the logic function expressed in POS form as below by grouping adjacent zeros.



In the above K-map shown, there are 2 groups of 2 adjacent zeros are possible as shown in map and the terms corresponding to these 2 groups are $(\bar{A}+\bar{C})$ & $(B+\bar{C})$

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So in simplified POS form Y can be given as

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

c) Formation of 5 -variable K-map:

As we know that K-map is formed by arranging no. of cells and the number of cells in the map depends on the number variables. So as 2^n. So in 5 -variable map there are total of $2^5 = 32$ number of cells required which will represent one of the combinations of 5 variables.

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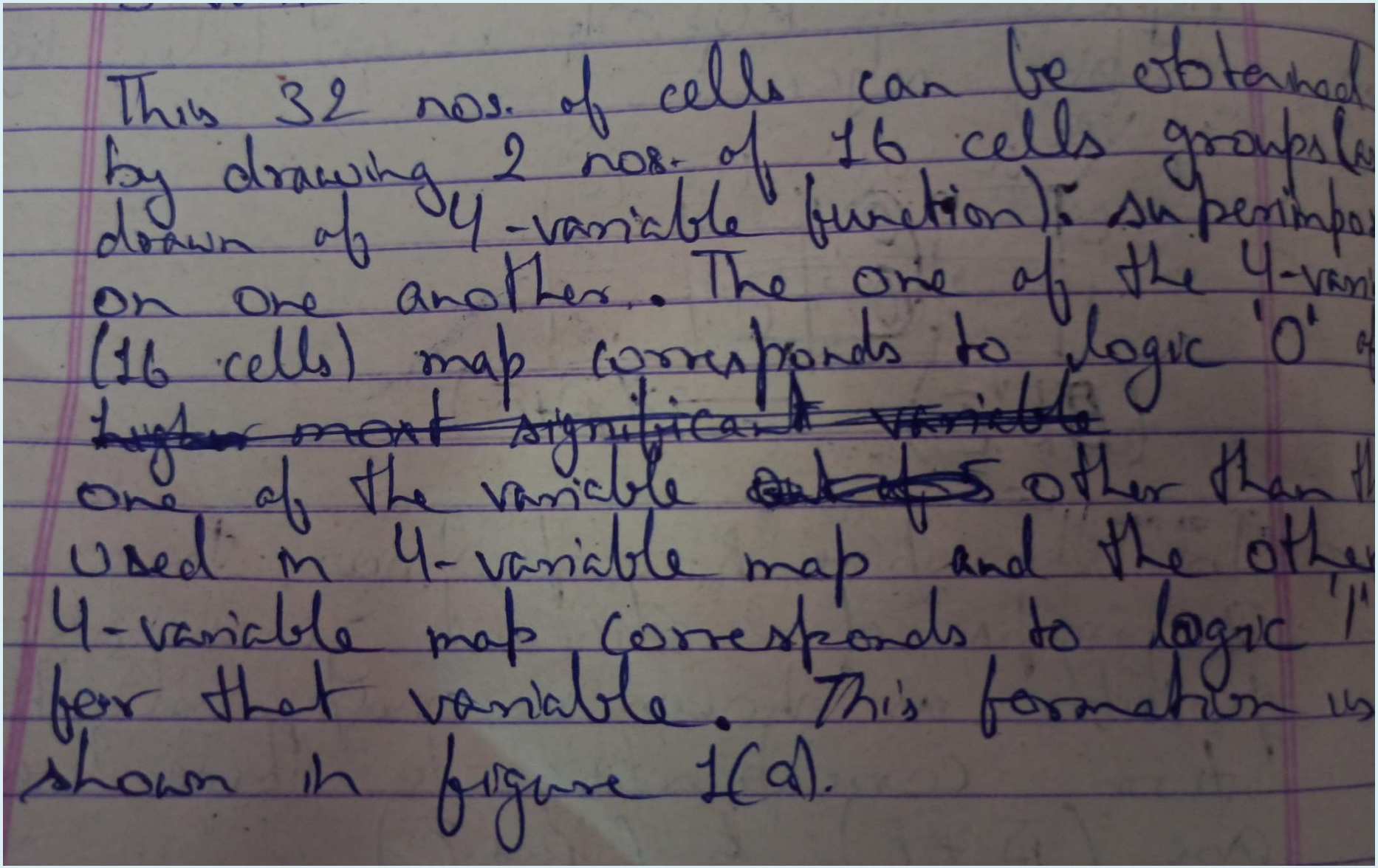
This 32 nos. of cells can be obtained by drawing 2 nos. of 16 cells groups (as drawn of 4-variable function) superimposed on one another. The one of the 4-variable (16 cells) map corresponds to logic '0' of ~~the most significant variable~~ one of the variable ~~outputs~~ other than the used in 4-variable map and the other 4-variable map corresponds to logic '1' for that variable. This formation is shown in figure 1(d).

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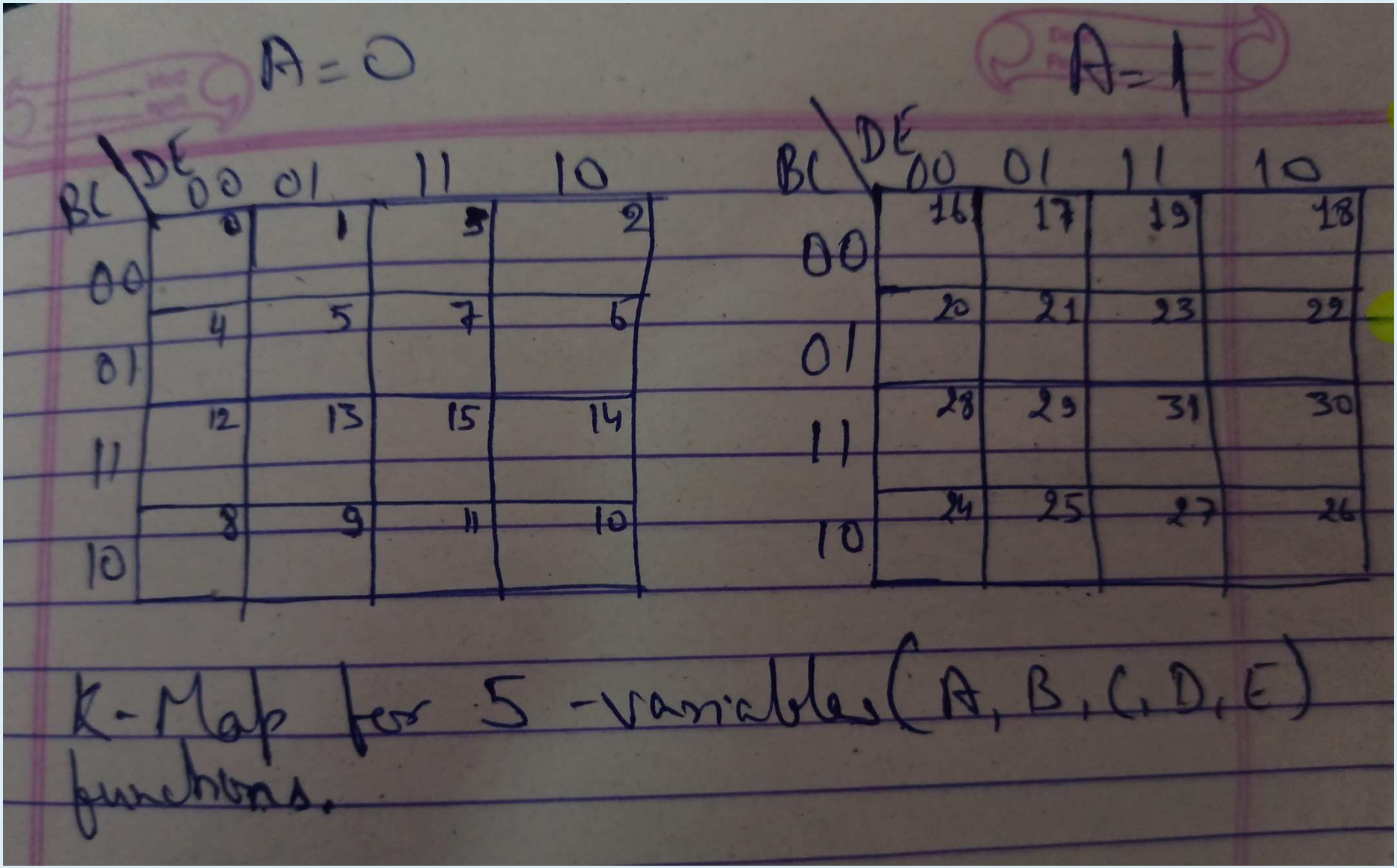

Combinational Logic Design

Refer book- Modern Digital Electronics by RP Jain.

Thank You