Paper 7, TDC Part-3
Chapter– 4, Combinational Logic Design
Lecture - 24

By:

Mayank Mausam

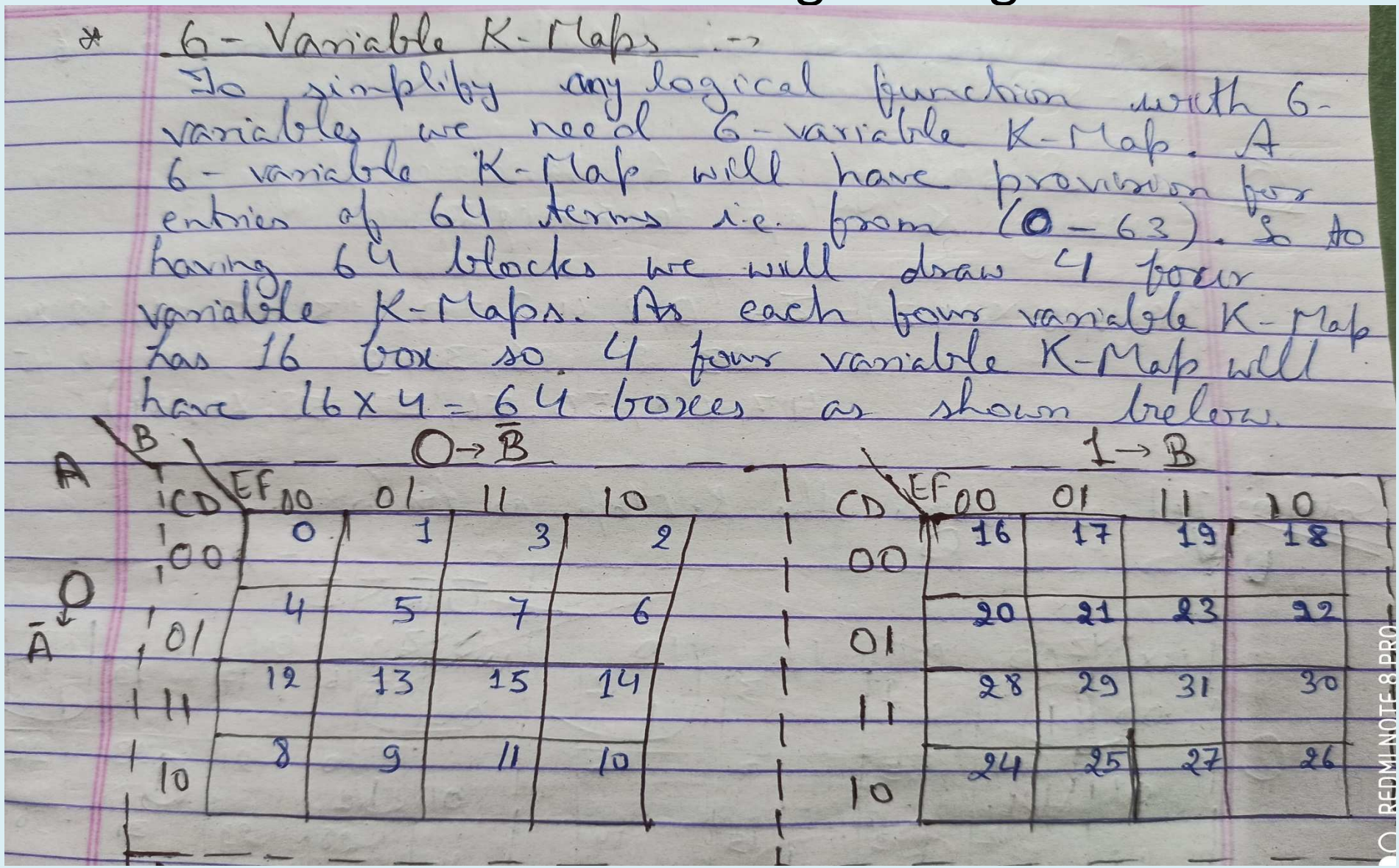
Assistant Professor (Guest Faculty)

Department of Electronics

L.S. College, BRA Bihar University,

Muzaffarpur, Bihar

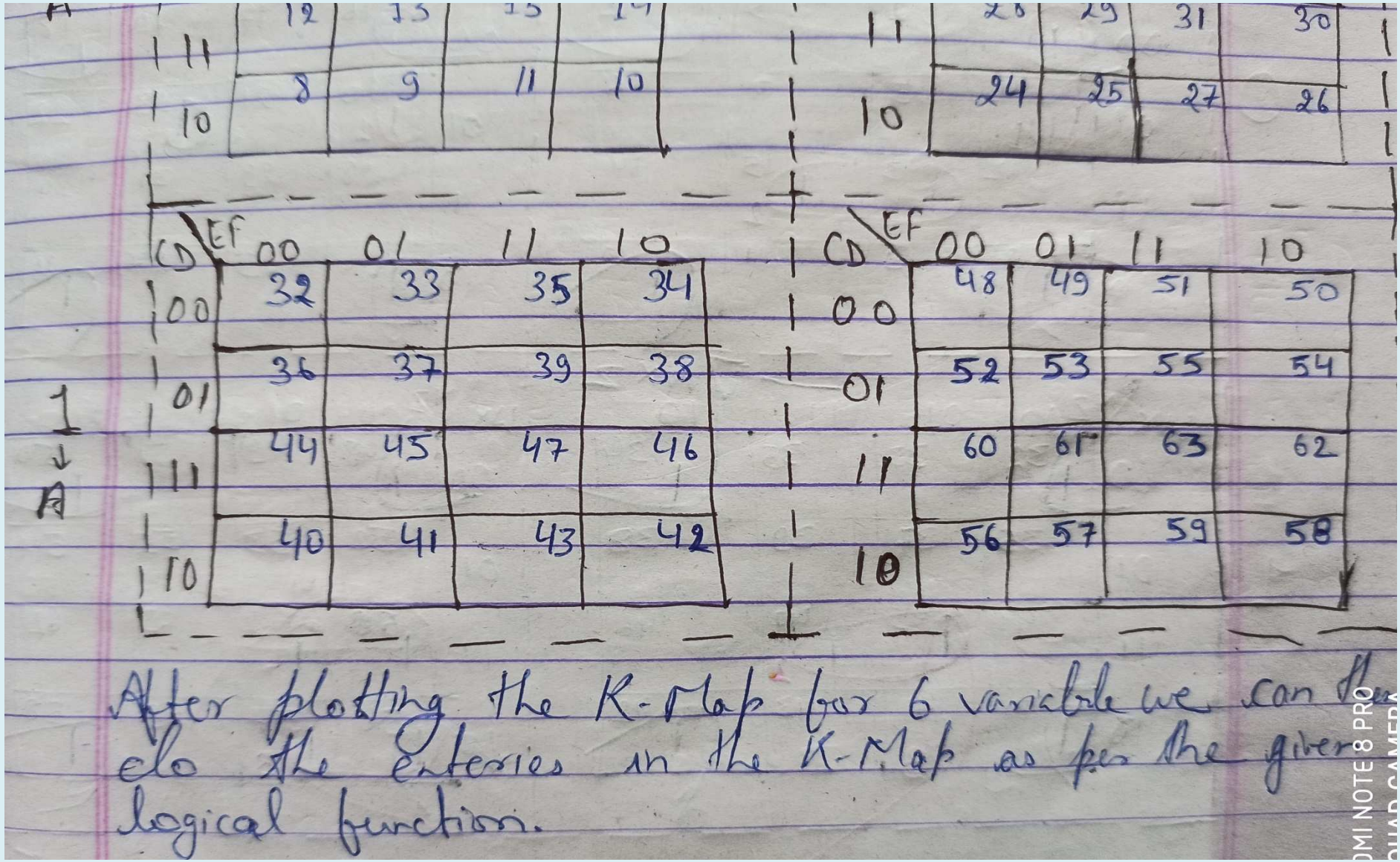
Combinational Logic Design



* 6-Variable K-Maps :→

To simplify any logical function with 6-variables we need 6-variable K-Map. A 6-variable K-Map will have provision for entries of 64 terms i.e. from (0-63). So to having 64 blocks we will draw 4 four variable K-Maps. As each four variable K-Map has 16 box so 4 four variable K-Map will have 16 × 4 = 64 boxes as shown below.

Combinational Logic Design



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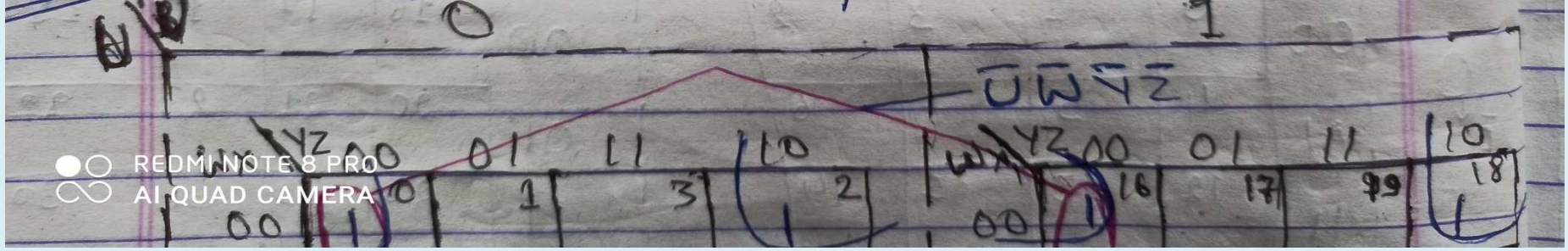
Let us see one example for SOP function of 6 - variables.

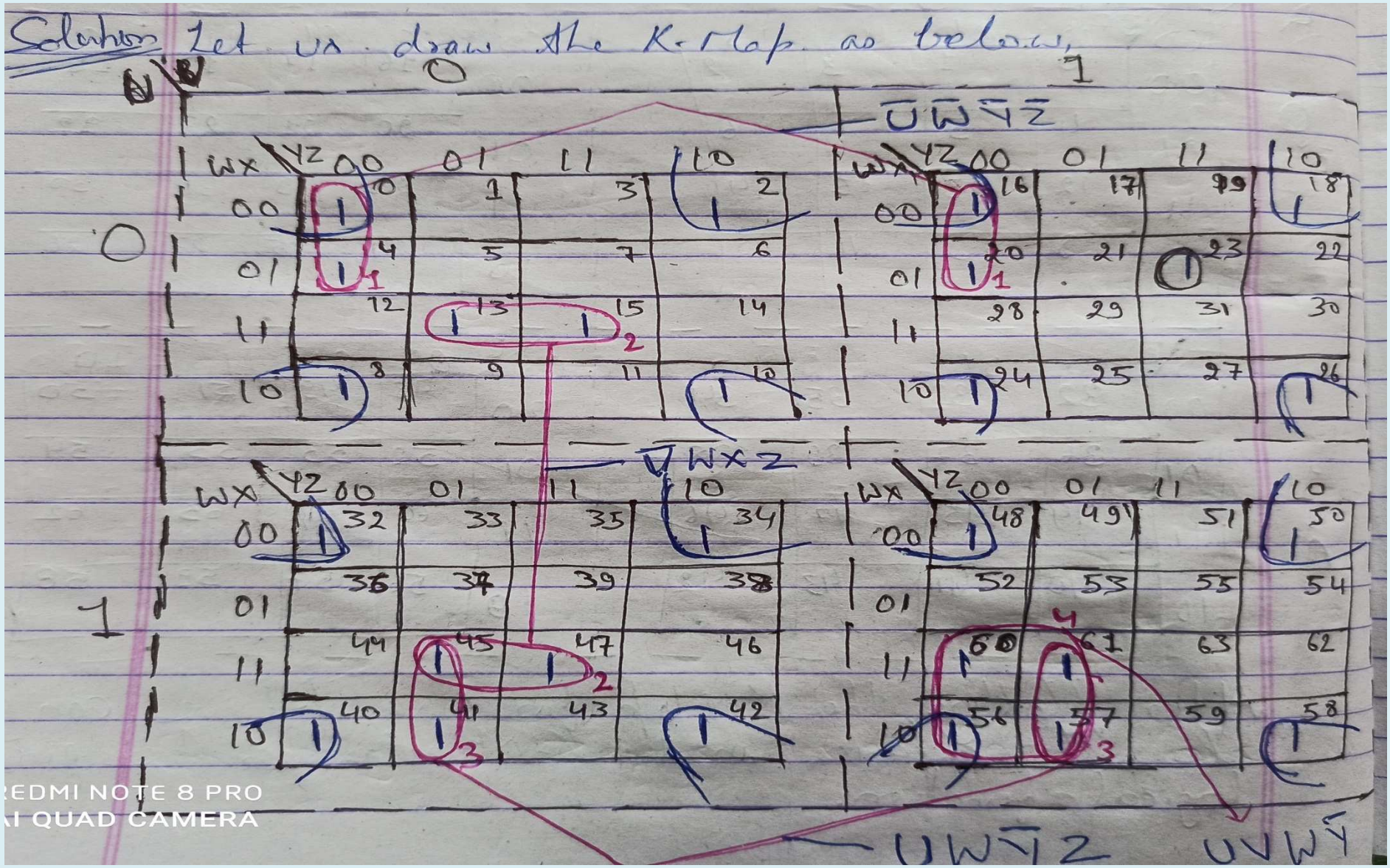
(Example-1) Simplify the 6-variable logic function using K-Map technique.

$f(U,V,W,X,Y,Z) = \Sigma m(0,2,4,8,10,13,15,16,18,20,23,24,26,32,34,40,41,42,45,47,48,50,56,57,58,60,61)$

Solution Let us draw the K-Map as below,



Combinational Logic Design



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Blue coloured box group is group of 16 ones and so the corresponding term is $\overline{X}\overline{Z}$

Pink coloured group marked '1' will form group of 4 ones and the corresponding term is $\overline{U}\overline{W}\overline{Y}\overline{Z}$

Pink coloured group marked '2' will form group of 4 ones and the corresponding term is $\overline{V}WXZ$

Pink coloured group marked '3' will form group of 4 ones and the corresponding term is $UW\overline{Y}Z$

Combinational Logic Design

Black coloured group is a 1 single one and can't be grouped with any ones the term is $\bar{U}V\bar{W}X\bar{Y}Z$

Pink coloured group marked '4' will form group of 4 ones and the corresponding term is $UVW\bar{Y}$

So the reduced/simplified logic expression is given as,

$$f(U,V,W,X,Y,Z) = \bar{X}\bar{Z} + \bar{U}\bar{W}\bar{Y}\bar{Z} + \bar{V}WXZ + UW\bar{Y}Z + UVW\bar{Y} + \bar{U}V\bar{W}XYZ$$

The above logic function can be implemented using basic gates and also we can use NAND-NAND two level implementation

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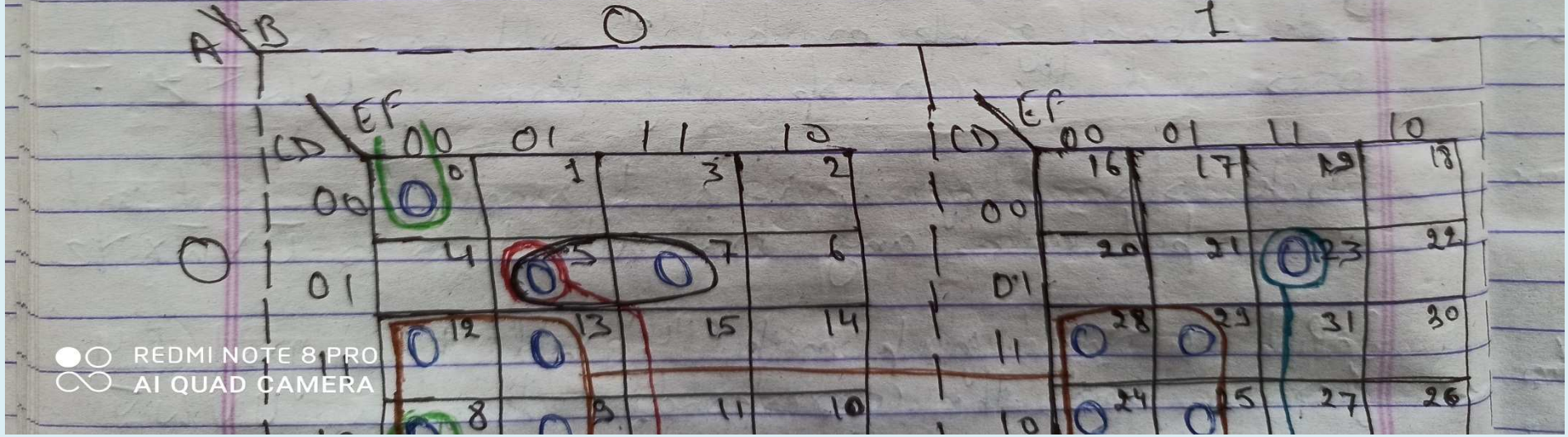
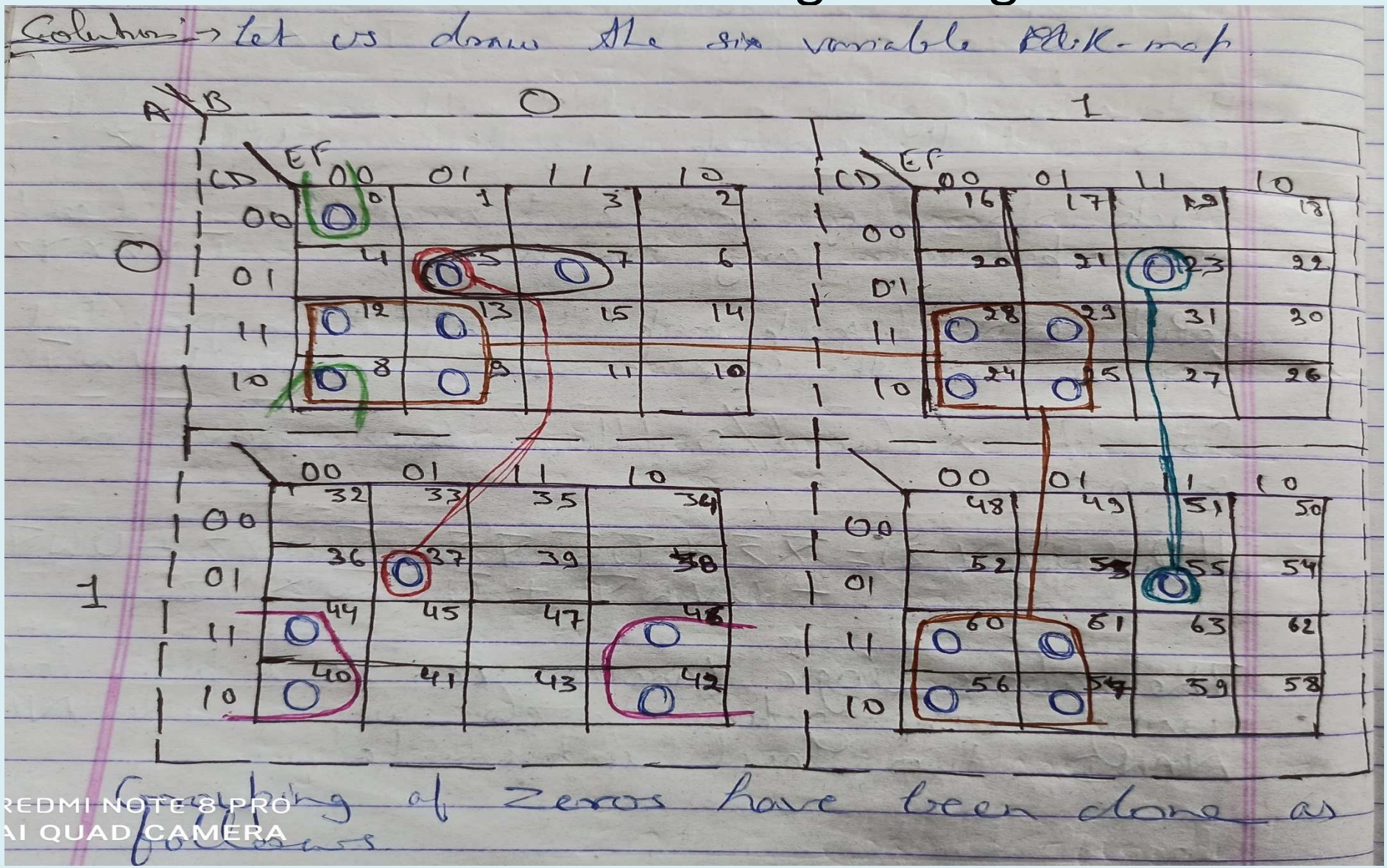
Example 2: Simplify the 6 variable logic expression using K-Map technique in POS form.

$$f(A,B,C,D,E,F) = \Pi M(0,5,7,8,9,12,13,23,24,25,28,29,37,40,42,44,46,55,56,57,60,61)$$

Solution: → Let us draw the six variable K-map



Combinational Logic Design



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There are 2 groups of 8 zeros and shown by orange colour.

12, 13, 8, 9, 24, 25, 28 & 29 form group of 8 zeros, and given by term $(A + \bar{C} + E)$

Also 24, 25, 28, 29, 56, 57, 60 & 61 form group of 8 zeros and given by term $(\bar{B} + \bar{C} + E)$

There is only one group of 4 zeros and shown by pink colour i.e. (40, 42, 46) and given by term $(\bar{A} + B + \bar{C} + F)$

Remaining zeros form group of 2 zeros and there are 4 group of 2 zeros.

Combinational Logic Design

Remaining zeros form group of 2 zeros and there are 4 group of 2 zeros.

Group of 2 zeros are $(0 \& 8) \rightarrow (A+B+D+E+F)$

" " " " $(5 \& 7) \rightarrow (B+C+\bar{D}+\bar{F}+A)$

$(5 \& 37) \rightarrow (B+C+\bar{D}+E+\bar{F})$

$(23 \& 55) \rightarrow (\bar{B}+C+\bar{D}+\bar{E}+\bar{F})$

So the function can be written in POS form as,

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

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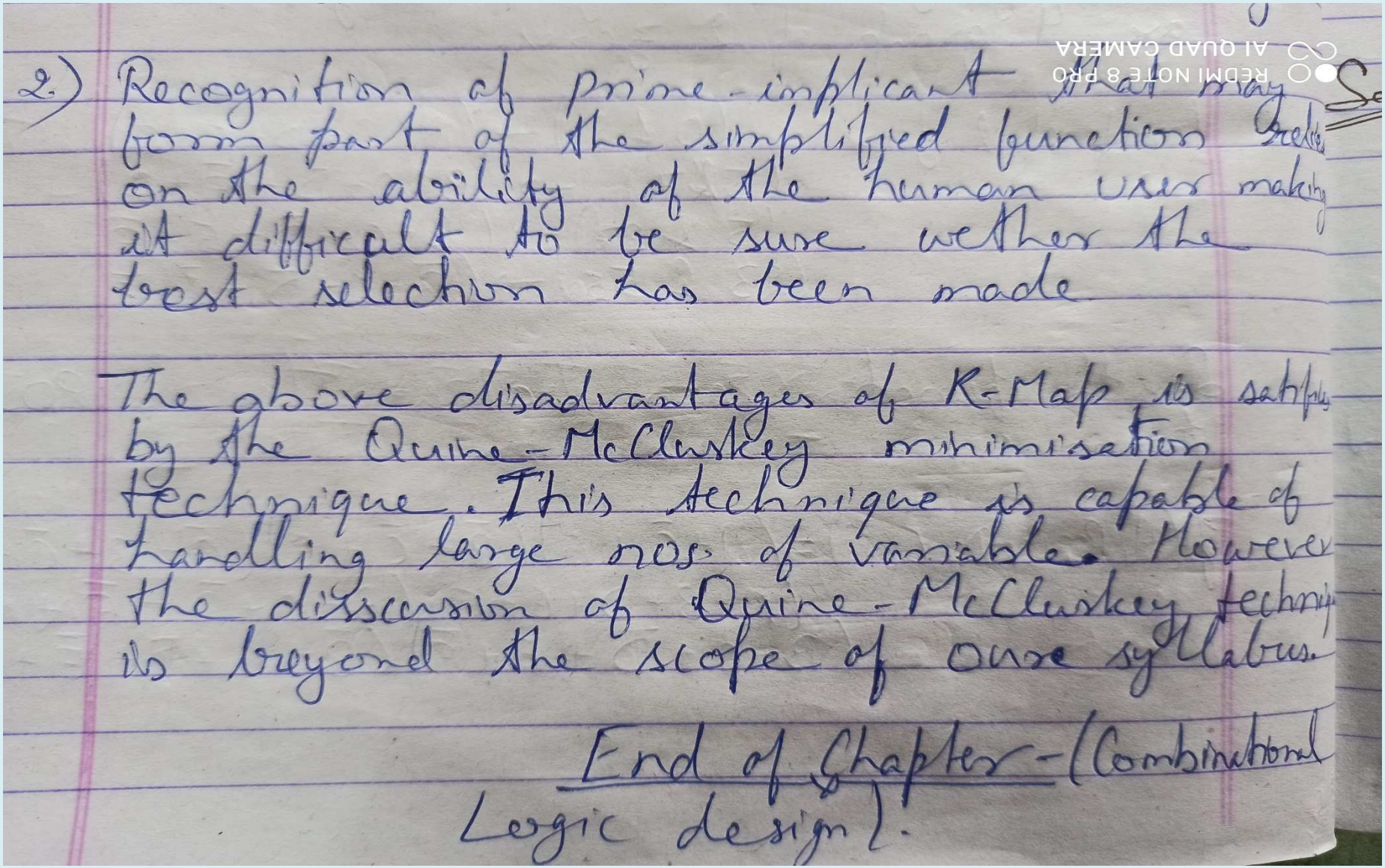

2.) Recognition of prime-implicant that may form part of the simplified function relies on the ability of the human user making it difficult to be sure wether the best selection has been made

The above disadvantages of K-Map is satisfied by the Quine-McCluskey minimisation technique. This technique is capable of handling large nos. of variables. However the discussion of Quine-McCluskey technique is beyond the scope of our syllabus.

End of Chapter - (Combinational Logic design).

Combinational Logic Design

Refer book- Modern Digital Electronics by RP Jain.

Thank You