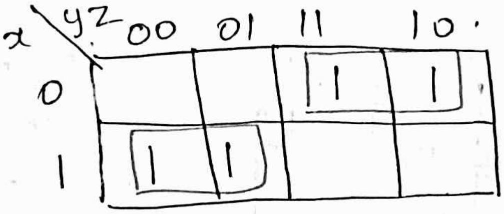
1) Simplify the Boolean function.

$F(x,y,z) = \Sigma(2,3,4,5)$.

3 variable k-map:



x \ yz	00	01	11	10
0			1	1
1	1	1		

$\bar{x}yz+\bar{x}y\bar{z} = \bar{x}y(z+\bar{z}) = \bar{x}y$.

$x\bar{y}\bar{z}+x\bar{y}z = x\bar{y}(\bar{z}+z) = x\bar{y}$.

$\Rightarrow \bar{x}y+x\bar{y}$ //.

Karnaugh Map:

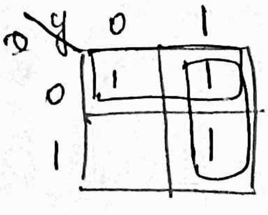
A karnaugh map is similar to a truth table because it presents all of the possible values of input variables and the resulting o/p for each value.

The map method ~~presented~~ here provides a simple, straight forward procedure for minimizing Boolean functions. This method may be regarded as a pictorial form of a truth table. The map method is known as karnaugh map or k-map.

The karnaugh map identifies all of the cases for a given set of input variables where groups of minterms may contain redundant variables of the form of $x+x'=1$. When these groups are identified, the redundant variables can be eliminated, resulting in a simplified o/p function.

2-Variable k-map:

$F(x,y) = \Sigma(0,1,3)$.



x \ y	0	1
0	1	1
1		1

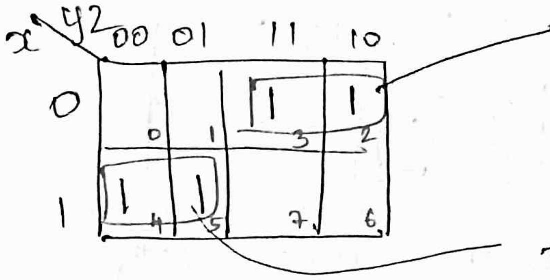
$\bar{x}\bar{y}+\bar{x}y \Rightarrow \bar{x}(\bar{y}+y)$
$= \bar{x}(1)$.

$\bar{x}y+xy = y(\bar{x}+x)$
$= y$

$= \bar{x}+y$ //

Three Variable K-Map:

$$\begin{array}{c} 001\,010\,011\,100\,101 \\ F(x,y,z). = \Sigma\cdot(2,3,4,5), \end{array}$$



$\bar{x}y\dot{z} + \bar{x}y\bar{z}$

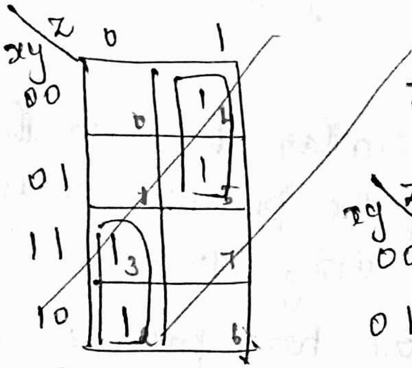
$\bar{x}y(z+\bar{z})$

$= \bar{x}y$

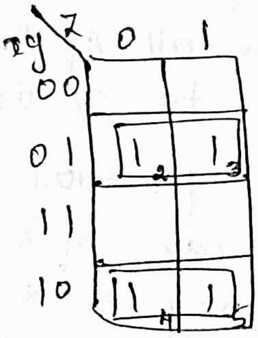
$x\bar{y}\bar{z} + x\bar{y}z$

$= x\bar{y}(\bar{z}+z) = x\bar{y}$

$\Rightarrow \bar{x}y + x\bar{y}$



$\bar{x}\bar{y}z + \bar{x}yz/ + .$



$\bar{x}y\bar{z} + \bar{x}yz$

$= \bar{x}y(z+\bar{z})$

$= \bar{x}y.$

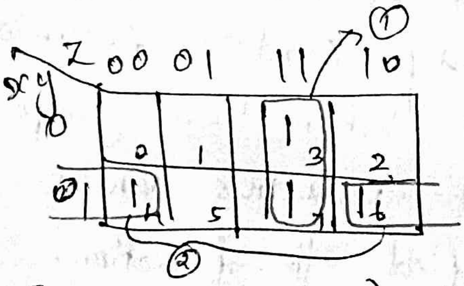
$x\bar{y}\bar{z} + x\bar{y}z = x\bar{y}(z+\bar{z}$

$= x\bar{y}$

$= x\bar{y} + \bar{x}y.$

Simplify the Boolean func.

2) $F(x,y,z) = \Sigma(3,4,6,7)$



① $\bar{x}yz + xyz = yz(x+\bar{x}) = yz.$

② $x\bar{y}\bar{z} + xy\bar{z} = x\bar{z}(x\bar{y}+y) = x\bar{z}$

$\Rightarrow yz + x\bar{z}$

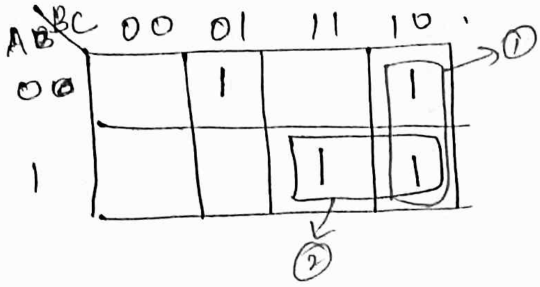
$xyz + xy\bar{z} = xy(z+\bar{z})$

$\Rightarrow xy.$

3) Map the following std SOP expression on a Karnaugh map.

$\bar{A}\bar{B}C + \bar{A}B\bar{C} + AB\bar{C} + ABC.$

001 010 110 111



AB\BC	00	01	11	10
00		1		1
1			1	1

① ⇒ $\bar{A}B\bar{C} + AB\bar{C}$

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

$= B\bar{C}$

② ⇒ $ABC + AB\bar{C}$

$= AB(C+\bar{C})$

$= AB.$

$= AB + B\bar{C}$ //.

4- Variable K-Map:-

4) Simplify the Boolean function.

$F(x,y,z) = \Sigma(0,2,4,5,6).$

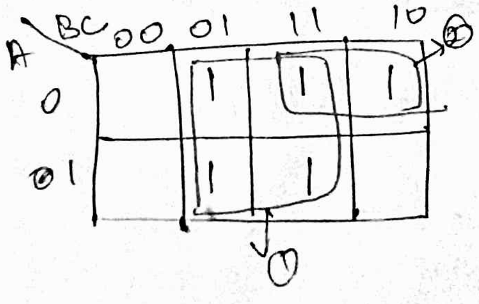
5). $F = A'C + A'B + AB'C + BC$

$\Rightarrow A'C(B+B') + A'B(C+C') + AB'C + BC(A+A')$

$= A'\underline{BC} + A'B'C + A'\underline{BC} + A'BC' + AB'C + ABC + A'\underline{BC}$

$= A'BC + A'B'C + A'BC' + AB'C + ABC$

011 001 010 101 111

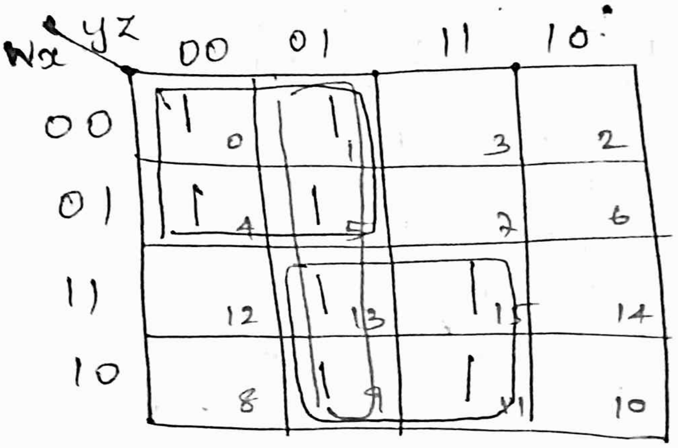


A\BC	00	01	11	10
0		1	1	1
01		1	1	

$C + \bar{A}B.$

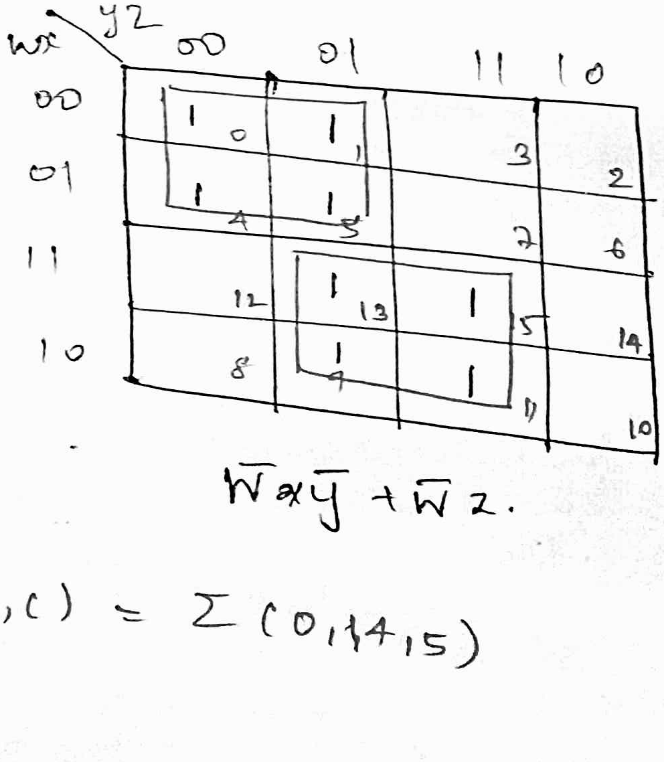
3) Simplify the following 4 - Variable equa

$K = f(w,x,y,z) = \Sigma(0,1,4,5,9,11,13,15)$



wx \ yz	00	01	11	10
00	1 0	1 1	3	2
01	1 4	1 5	7	6
11	12	1 13	1 15	14
10	8	1 9	1 11	10

$\cancel{yx} + \bar{w}\bar{y} + \bar{w}z$



wx \ yz	00	01	11	10
00	1 0	1 1	3	2
01	1 4	1 5	7	6
11	12	1 13	1 15	14
10	8	1 9	1 11	10

$\bar{W}x\bar{y} + \bar{W}z.$

4) $Y = f(a,b,c) = \Sigma(0,1,4,5)$

8) Simplify the following 3 variable eq

$J = f(x, y, z) = \Sigma\ (0, 2, 3, 4, 5, 7)$

9) $L = f(a, b, c, d) = \Sigma(0, 2, 5, 7, 8, 10, 13, 15)$

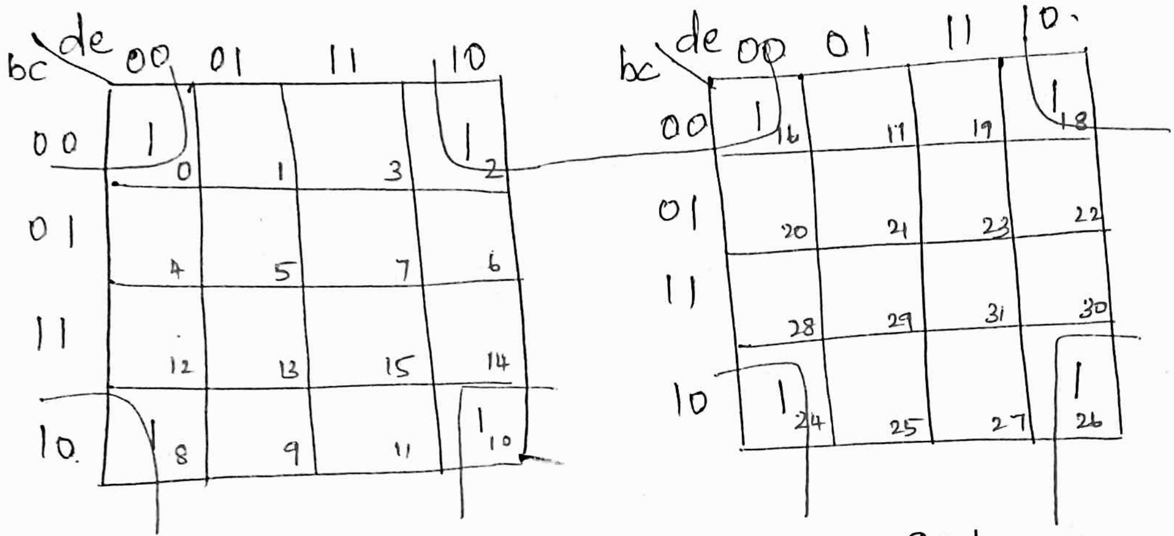
10) Simplify the following eqn

$P = f(r, s, t, u) = \Sigma\ (1, 3, 4, 6, 9, 11, 12, 14)$

Five - Variable K - Map:

1) Five variable K - Map for

$T = f(a,b,c,d,e) = \Sigma(0,2,8,10,16,18,24,26).$



a=1.

a=0

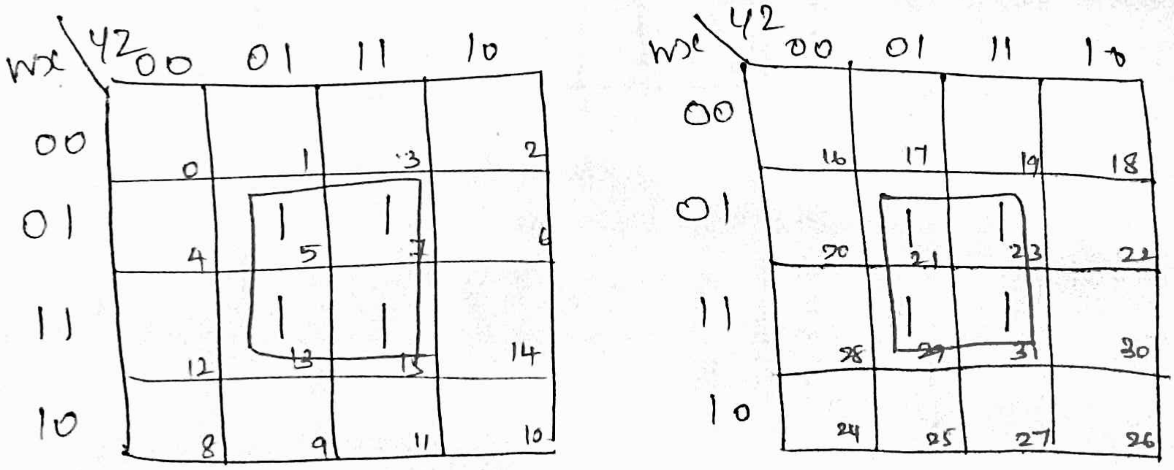
$\bar{c}\,\bar{e}$ //

2) Five - variable k-map for $R = f(v,w,x,y,z)$

$= \Sigma(5,7,13,15,21,23,29,31)$

V=0

v=1

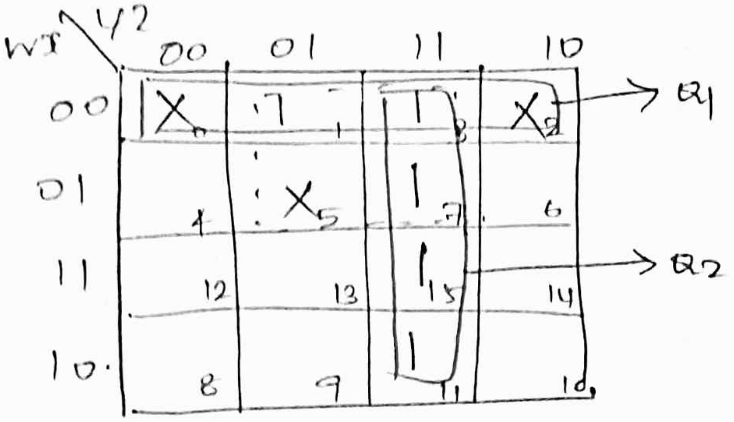


$R = xz$ //

Dont Care Conditions:

$F(w,x,y,z) = \Sigma(1,3,7,11,15)$

$d(w,x,y,z) = \Sigma(0,2,5)$



wx \ yz	00	01	11	10
00	X 0	1 1	1 3	X 2
01	4	X 5	1 7	6
11	12	13	1 15	14
10	8	9	1 11	10

$Q_1 = \bar{w}\bar{x}$

$Q_2 = yz$

$F = \bar{w}\bar{x} + yz.$

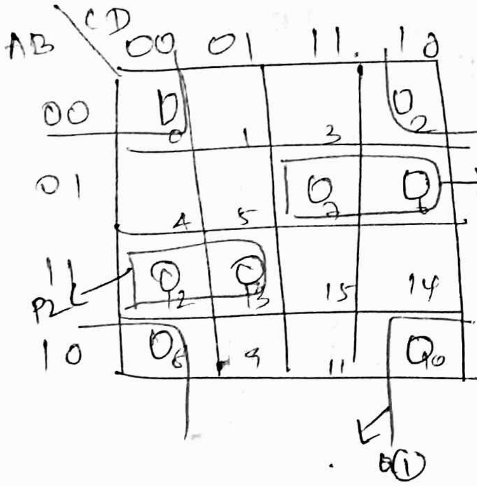
2) $A = f(w,x,y,z) = \Sigma(5,6,7,8,9) + \Sigma d(10,11,12,13,14,15)$

wx \ yz	00	01	11	10
00	0	1		
01				
11				
10				

1) $\Pi m(1,7)$.

2) $F(A,B,C,D) = \Sigma m(1,3,4,5,9,11,14,15)$

$F(A,B,C,D) = \Pi m(0,2,6,7,8,10,12,13)$



$Q_1 = (B+D)$

$P_1 = (\overline{C}+A+\overline{B})$

$P_2 = (\overline{A}+\overline{B}+C)$.

$\Rightarrow (\overline{B}+\overline{D})(A+\overline{B}+\overline{C})(\overline{A}+\overline{B}+C)$

3) Use K map to minimize the following exp.

$(B+C+D)\cdot(A+B+\overline{C}+D)(\overline{A}+B+C+\overline{D})(A+\overline{B}+C+D)$

$(\overline{A}+\overline{B}+C+D)$.

Std POS

$(B+C+D+A\overline{A}) = (A+B+C+D)\cdot(\overline{A}+B+C\cdot D)$

0 0 0 0   1 0 0 0   0 0 1 0   1 0 0 1.

$\Rightarrow (A+B+C+D)(\overline{A}+B+C+D)(A+B+\overline{C}+D)(\overline{A}+B+C+\overline{D}$

$(A+\overline{B}+C+D)(\overline{A}+\overline{B}+C+D)$

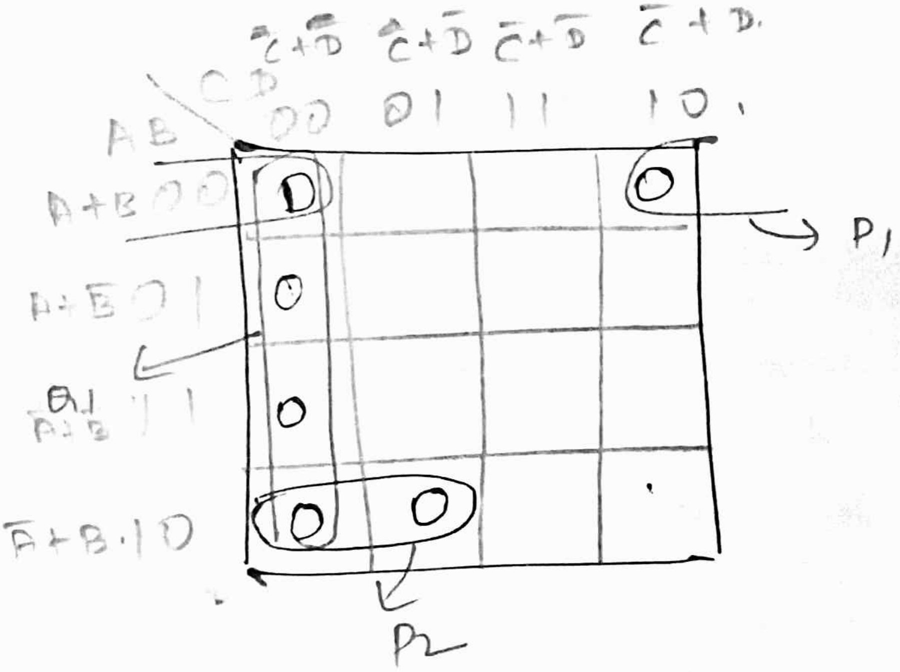
0 1 0 0   1 1 0 0

$Q_1 = \overline{C} + \overline{D}$

$\Rightarrow \overline{C} + D.$

$P_1 = A+B+D.$

$P_2 = \overline{A}+B+C.$



$\Rightarrow (A+B+D)(\overline{A}+B+C)(C+D).$

4) $(\overline{A}+\overline{B}+C+D)(A+\overline{B}+C+D)(A+B+C+\overline{D})$