① Implement using minterms K-map ~~& simplify expression~~

$$F = A.(B+C) + D$$

Soln $F = A.B + A.C + D$ (using distributive prop)

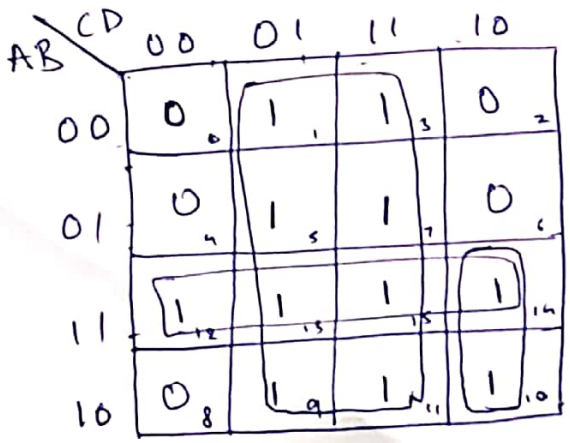
$$\Rightarrow F = A.B(C+\bar{C})(D+\bar{D}) + A.C(B+\bar{B})(D+\bar{D}) + D(A+\bar{A})(B+\bar{B})(C+\bar{C})$$

(∵ any $x+\bar{x}=1$ & $p.1 = p$)

$$= AB\bar{C}D + AB\bar{C}D + AB\bar{C}\bar{D} + AB\bar{C}\bar{D} + ABCD + ABC\bar{D} + A\bar{B}CD + A\bar{B}C\bar{D} + ABCD + AB\bar{C}D + A\bar{B}CD + A\bar{B}\bar{C}D + \bar{A}BCD + \bar{A}B\bar{C}D + \bar{A}\bar{B}CD + \bar{A}\bar{B}\bar{C}D$$

Eliminating Repeating terms (∵ $x+x=x$),

$$\Rightarrow F = ABCD + AB\bar{C}D + AB\bar{C}\bar{D} + AB\bar{C}\bar{D} + A\bar{B}CD + A\bar{B}C\bar{D} + A\bar{B}\bar{C}D + \bar{A}BCD + \bar{A}B\bar{C}D + \bar{A}\bar{B}CD + \bar{A}\bar{B}\bar{C}D$$



$F = D + AB + AC$

or $F = \sum(1, 3, 5, 7, 12, 13, 14, 15, 9, 10, 11)$

(2) Simplify using maxiterms K-map

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

Sol^n

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

($\because x\bar{x} = 0$ & $y+0 = y$)

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

(using distributive of '+' over '.')

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

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

(eliminating common terms $\because A \cdot A = A$)

AB \ CD	00	01	11	10
00	1 $_0$	1 $_1$	1 $_3$	1 $_2$
01	1 $_4$	1 $_5$	1 $_7$	1 $_6$
11	0 $_{12}$	0 $_{13}$	0 $_{15}$	0 $_{14}$
10	0	1 $_9$	1 $_{11}$	1 $_{10}$

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

or $F = \Pi(8, 12, 13, 14, 15)$

(3) Simplify using K-map and derive Boolean Expression for the following,

$$F = \sum (1, 4, 9, 14, 6, 12, 13)$$

Soln

AB \ CD	00	01	11	10
00	0_0	1	0_3	0_2
01	1	0_5	0_7	1
11	1	1	0_{15}	1
10	0_8	1	0_{11}	0_{10}

$$F = B\bar{D} + \bar{B}\bar{C}D + A\bar{C}D$$