→ POS (3 i/p gate) :

| A | B | C | Y |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 1 | 1 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 1 | 0 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 0 |

Take complement

Given

Normal → 0

Complement → 1

| $Y_1$ |
|---|
| 1 |
| 1 |
| 1 |
| 0 |
| 1 |
| 1 |
| 0 |
| 1 |

SOP → $\therefore Y = ABC + AB\bar{C} + A\bar{B}C + \bar{A}BC + \bar{A}B\bar{C} + \bar{A}\bar{B}\bar{C}$

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

* Complete Minterm, Maxterm, SOP → SSOP, POS → SPOS, before K-Map.

# KARNAUGH MAP [K-Map] : (no. of cells → $2^n$ cells).

* Two variable K-Map :
  ↳ $2^2 = 4$

| A \ B | 0 | 1 |
|---|---|---|
| 0 | 0 | 1 |
| 1 | 2 | 3 |

* Three variable K-Map : $2^3 = 8$.

| A \ BC | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 0 | 0 | 1 | 3 | 2 |
| 1 | 4 | 5 | 7 | 6 |

~~* Two VA~~

* Four variable K-Map : $2^4 = 16$

| AB \ CD | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 0 | 1 | 3 | 2 |
| 01 | 4 | 5 | 7 | 6 |
| 11 | 12 | 13 | 15 | 14 |
| 10 | 8 | 9 | 11 | 10 |

Order to take binary :

00 → 01 → 11 → 10

Just change one no. either left or right but not both

To sym. values, convert binary to decimal (as else sym.).

ex : $(1111)_2 \longrightarrow (15)_{10}$

$(1011)_2 \longrightarrow (11)_{10}$

→ Rules for creating group in K-Map :

* No zeros allowed
* Group can be vertical / horizontal but not diagonals.
* Overlapping allowed
* Group should be as large as possible
* Group must contain $2^n$ cells.

⇛ $F(A,B) = \Sigma(0,2,3)$

Step-1 : Draw K-Map according to var

Step-2 : put "1" on cells given in bracket

Step-3 : put binary above box

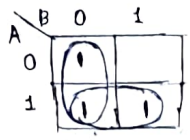
Step-4 : Take pairs as large as possible

Step-5 : Put values of cell, containing '1'

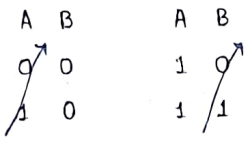
Step-5 : Cancel values having 0 & 1 both

Step-6 : $\overline{A} \rightarrow 0$
$A \rightarrow 1$

Soln A, B → Two variable




∴ $P_1$ $P_2$

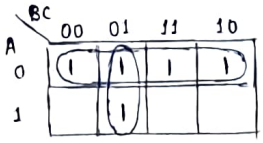



∴ Put $0 \rightarrow \overline{A}$
$1 \rightarrow A$

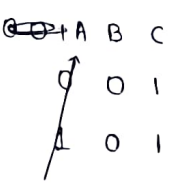
∴ $F(A,B) \rightarrow B' + A$ (Ans)

⇛ $F(A,B,C) = \Sigma(0,1,2,3,5)$

Soln




$P_1$ $P_2$

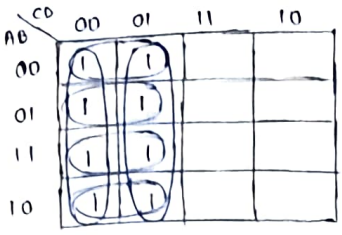



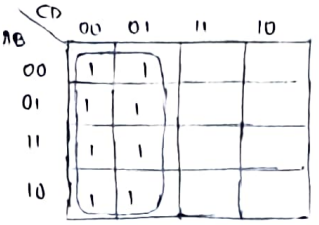

A

$F(A,B,C) = A' + B'C$ (Ans)

⇒ $F(A,B,C,D) = \Sigma(0,1,4,5,8,9,12,13)$

Soln)




↳ we have to take grp as large as possible

we can take a grp of 8 or 4 or 2 or 1

∴ EP1

| A | B | C | D |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 0 | 1 |
| 0 | 1 | 0 | 0 |
| 0 | 1 | 0 | 1 |
| 1 | 1 | 0 | 0 |
| 1 | 1 | 0 | 1 |
| 1 | 0 | 0 | 0 |
| 1 | 0 | 0 | 1 |

∴ $C'$ (Ans).

# MinTerm & MaxTerm :

* Minterm ⟶ Each individual term in SSOP
* Maxterm ⟶ Each individual term in SPOS.

| Variable | | Minterm | Maxterm |
|---|---|---|---|
| A | B | SSOP | SPOS |
| 0 | 0 | $\bar{A}\bar{B} \rightarrow m_0$ | $A+B \rightarrow M_0$ |
| 0 | 1 | $\bar{A}B \rightarrow m_1$ | $A+\bar{B} \rightarrow M_1$ |
| 1 | 0 | $A\bar{B} \rightarrow m_2$ | $\bar{A}+B \rightarrow M_2$ |
| 1 | 1 | $AB \rightarrow m_3$ | $\bar{A}+\bar{B} \rightarrow M_3$ |

for SOP: 0 → complement, 1 → normal

for POS: 0 → normal, 1 → complement

* ex : $f(A,B) = AB + \bar{A}B$

Soln) it is SOP ⟶ $\underset{\downarrow}{11}\ AB + \underset{\downarrow}{01}\ \bar{A}B$

$\downarrow \quad \downarrow$

$3 \quad 1$

∴ $\Sigma m(1,3)$

⇒ $f(A,B) = (A+B)(\bar{A}+B)$

Soln

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

0 0 1 0

↓ ↓

0 2

$\therefore$ ~~SOM(0,2)~~

$\pi M(0,2)$

→ SOP & SSOP :

* SSOP ⟶ The function should contain all variables in every product

i.e, $AB'+A$ (✗ SSOP) (✓ SSOP)

$ABC'+A'B$ (✗ SSOP) (✓ SSOP)

$A'C+AB'+BC$ (✗ SSOP) (✓ SSOP)

** Converting SSOP to CSSOP

⇒ $AB'+A$

Soln $AB'+A(1)$

$AB'+A(B+B')$

$AB'+AB+AB'$

$AB'+AB$ (SSOP)

⇒ $ABC'+A'B$

Soln $ABC'+A'B(1)$

$ABC'+A'B(C+C')$

$ABC'+A'BC+A'BC'$

⇒ $A'C+AB'+BC$

Soln $A'C(1)+AB'(1)+BC(1)$

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

$A'BC+A'CB'+AB'C+AB'C'+ABC$

* → SPOS to CPOS (canonical) :

⇒ $(A'+B)B$

Soln $(A'+B)(B+0)$

$(A'+B)(B+A\cdot A')$

$(A'+B)(B+A)(B+A')$

⇒ $(A'+B)(A+B)$

⇒ $(A+B)(B+C')(A'+C)$

Soln $(A+B+0)(B+C'+0)(A'+C+0)$

$(A+B+CC')(B+C'+AA')(A'+C+BB')$

$(A+B+C)(A+B+C')(B+C'+A)(B+C'+A')(A'+C+B)$

$(A'+C+B')$

$(A+B+C)(A+B+C')(B+C'+A')(A'+C+B)(A'+C+B')$