conversion

1. of decimal base 10

Binary (repeated division by 2)

octal (repeated div by 8)

Hex. (repeated ÷ by 16)

```
2|356
2|178 - 0
2| 89 - 0
2| 44 - 1
2| 22 - 0
2| 11 - 0
2|  5 - 1
2|  2 - 1
    1 - 0
```

```
8|356
8| 44 - 4
    5 - 4
```

$(544)_8$

```
16|356
16| 22 - 4
     1 - 6
```

$(164)_{16}$

Resultant

Binary value $\Rightarrow (101100100)_2$

Octal value $\Rightarrow (544)_8$

Hex value $\Rightarrow (164)_{16}$

2. 356.87

.87

To binary :-

$0.87 \times 2 = 1.74$

$0.74 \times 2 = 1.48$

$0.48 \times 2 = 0.96$

$0.96 \times 2 = 1.92$

$0.92 \times 2 = 1.84$

$0.84 \times 2 = 1.68$

1. Take only decimal value repeatedly

2. Take the integer value from top to bottom

$356.87 \Rightarrow$ binary $\Rightarrow (101100100.110111)_2 \ldots$

Scanned by CamScanner

To octal

.87

$0.87 \times 8 = 6.96$ upto 5 values.

$0.96 \times 8 = 7.68$

$0.68 \times 8 = 5.44$

$\Rightarrow (544.675)_8$

To hex

.87

$0.87 \times 16 = 13.92 \Rightarrow D.92$

$0.92 \times 16 = 14.72 \Rightarrow E.72$

$0.72 \times 16 = 11.52 \Rightarrow B.52$

$0.52 \times 16 = 8.32 \Rightarrow 8.32$

$\Rightarrow (164.DEB8)_{16}$

CONVERSION OF BINARY TO DECIMAL.

$(110110)_2 \Rightarrow (54)_{10}$ [decimal]

$0 \times 2^0 = 0$

$+$

$1 \times 2^1 = 2$

$+$

$1 \times 2^2 = 4$

$+$

$0 \times 2^3 = 0$

$+$

$1 \times 2^4 = 16$

$+$

$1 \times 2^5 = 32$

54

CONVERSION OF BINARY TO OCTAL.

1.Q) $(110110)_2 = (66)_8$

MSB LSB

① start from least significant bit [last value] (or) LSB ↓ Bit

MSB ⇒ Most significant bit

② Group it in terms of 3 from right (LSB)

OCTAL IN BINARY :-

0 - 000
1 - 001
2 - 010
3 - 011
4 - 100
5 - 101
6 - 110
7 - 111

2.Q) $(001101111101)_2 = (1575)_8$

CONVERSION OF BINARY TO HEXA DECIMAL.

8 4 2 1 → weight of binary

Group into 4

0 - 0000
1 - 0001
2 - 0010
3 - 0011
4 - 0100
5 - 0101
6 - 0110
7 - 0111
8 - 1000
9 - 1001
A - 1010
B - 1011
C - 1100
D - 1101
E - 1110
F - 1111

19) $(0110110)_2 = (36)_{16}$

20) $(0110111101)_2 = (37D)_{16}$

I. convert the following numbers to DECIMAL

1. 10110.0101
2. $(16.5)_{16}$
3. $(26.24)_8$
4. $(DADA.B)_{16}$

1. 10110.0101

$0 \times 2^0 \longrightarrow 0$

$1 \times 2^1 \longrightarrow 2$

$1 \times 2^2 \longrightarrow 4$

$0 \times 2^3 \longrightarrow 0$

$1 \times 2^4 \longrightarrow 16$

$\underline{\quad 22 \quad}$

0.0101

0×2^{-1}

$1 \times 2^{-2} \longrightarrow \frac{1}{4}$

0×2^{-3}

$1 \times 2^{-4} = \frac{1}{16}$

$22 + 1/16 + 1/4 = (22.3125)_{10}$

.0101

22.3125

2. $(16.5)_{16}$ to decimal

$6 \times 16^0 = 6$

$1 \times 16^1 = 16$

$0.5 \times 16^{-1} = 5/16$

$\Rightarrow 6 + 16 + 5/16 = (22.3125)_{10}$

3. $(26.24)_8$

$6 \times 8^0 \rightarrow 6$

$2 \times 8^1 \rightarrow 16$

0.24

$2 \times 8^{-1} = 2/8$

$4 \times 8^{-2} = 4/64$

$\Rightarrow 6 + 16 + 2/8 + 4/64$

$= 22 + 20/64 = 22 + 5/16 = (22.3125)_{10}$

4. $(DADA.B)_{16}$

D A D A . B

13×16^1 10×16^0 $\underline{11} \times 16^{-1}$

10×16^2

13×16^3

$\Rightarrow 53248 + 2560 + 208 + 10 + 0.6875$

$= (56026.6875)_{10}$

6.7.18

• 01101111 0110

to decimal.

11011110110

$0 \times 2^0 = 0$
$1 \times 2^1 = 2$
$1 \times 2^2 = 4$
$0 \times 2^3 = 0$
$1 \times 2^4 = 16$
$1 \times 2^5 = 32$
$1 \times 2^6 = 64$
$1 \times 2^7 = 128$
$0 \times 2^8 = 0$
$1 \times 2^9 = 512$
$1 \times 2^{10} = 1024$

1782

$(1782)_{10}$.

TO hexa decimal $\rightarrow (6F6)_{16}$, To octal $(3366)_8$

⇓

0110 1111 0110

$(6F6)_{16}$

⇓

$(3366)_8$

011 011 110 110

BINARY CODES

ASCII → American Standard Code for Information Interchange.

✓ $\boxed{8421}$ → Binary code ⇒ 0 to 15 → hexadecimal

84-2-1

✓ 2421

✓ BCD

✓ Gray

✓ Biquinary

Excess-3

~~Binary coded decimal~~ WEIGHTED CODES,

Binary coded Decimal

	~~8421~~ BCD	84-2-1	~~BCD~~ 2421 ~~84-2-1~~	(Non Weighted) Excess 3 +3 to BCD
0	0000	0000	0000	0011
1	0001	0111	0001	0100
2	0010	0110	0010	0101
3	0011	0101	0011	0110
4	0100	0100	0100	0111
5	0101	1011	1011	1000
6	0110	1010	1100	1001
7	0111	1001	1101	1010
8	1000	1000	1110	1011
9	1001	1111	1111	1100

Gray code [Non weighted codes]

Reflected code (or) Unit distance code.

(0 to 15)

	Gray code
0	0000
1	0001
2	0011
3	0010
4	0110
5	0111
6	0101
7	0100
8	1100
9	1101
10	1111
11	1110
12	1010
13	1011
14	1001
15.	1000

Excess-3

0011
~~0010~~ 0100
1011
1100
1101
1110
1111

Biquinary (Weighted)

	Bi	quinary
	50	43210
0	01	00001
1	01	00010
2	01	00100
3	01	01000
4	01	01100
5	10	00001
6	10	00010
7	10	00100
8	10	01000
9	10	1000

Finding of ones parity.

$\boxed{0}$1011000 → no of 1s is 3
odd parity

1 1011000 → no of 1s is 4
even parity.

Signed Numbers / Integers.

Decimal → 9's (Diminished radix), 10's (Radix)

Sign magnitude form

+13 → (0) signed nos
−13 → (1)

13 00001101
+13 00001101
−13 10001101
MSB add(1)
[can be of 8 (or) 5 bit]

One's complement (Diminished Radix comp)

+ → same
− → take complement
1→0, 0→1

00001101
00001101
11110010

Two's complement (Radix)

− → take complement
1→0, 0→1
add +1.

$$\begin{array}{r} 11110010 \\ +\ \ \ \ 1 \\ \hline 11110011 \\ \hline \end{array}$$

00001101
00001101
11110010

[In computers subtraction is done in 2's complement]

BINARY ADDITION

A	B	CY
0	0	0 0
0	1	0 0
1	0	0 0
1	1	1 0

carry

TRUTH TABLE

10+1=>11

1Q)

```
  1 0 1 1
  1 1 1 1
 ---------
1 1 0 1 0
 ---------
```

Summation is more than the required bit it is called as **CARRY**

2Q)

```
  1 1 0 1
  1 1 0 1
  1 1 0 1
 ---------
1 0 0 1 1 1
 ---------
```

```
2 | 25
2 | 12 - 1
2 | 6 - 0
2 | 3 - 0
    1 - 1
```

8 4 2 1
1 1 1 1

1.Q)

	sign Mag.	1's comp	2's comp
25	00011001		
+25	00011001	00011001	00011001
-25	10011001	~~00011010~~ 11100110 +1	11100111

BINARY SUBTRACTION

```
  0 10
  1 0 1 1
(−) 1 1 0 1
-----------
  1 1 0 1
```

0
10
11
100

Steps

1. first no. take as it is
2. 2nd no take 2's comp
3. add both

By 2's comp method.

```
13 →   1 1 0 1  ——→   1 1 0 1
11 → − 1 0 1 1        0 1 0 1
                     ---------
                     1 0 0 1 0
```

1's comp

```
   0 1 0 0
+        1
----------
   0 1 0 1
```

2's comp

```
  11    1 0 1 1      1 0 1 1
− 13    1 1 0 1      0 0 1 1
                    ---------
                    1 1 1 0  → 2's
```

~~0 0 1 0~~

```
  0 0 0 1
+       1
---------
  0 0 1 0
```

LOGIC GATES

AND $Y = A \cdot B$

OR $Y = A + B$ [diff from binary addition]

NOT $Y = \overline{A}$

} Basic gates

NAND $Y = \overline{A \cdot B}$ NOT + AND

NOR $Y = \overline{A + B}$ NOT + OR

} Universal gates

XOR $Y = A \oplus B \Rightarrow \overline{A}B + B\overline{A}$

X NOR $Y = A \odot B \Rightarrow AB + \overline{A}\,\overline{B}$

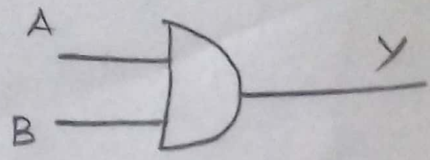
Both are complementary to each other.

$$\overline{A \oplus B} = A \odot B$$

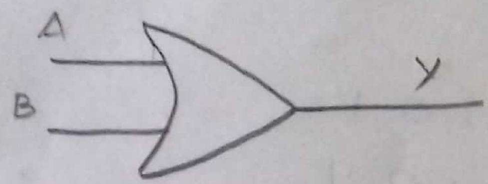
$$\overline{A \odot B} = A \oplus B$$

Symbols

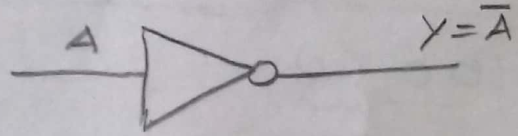
AND



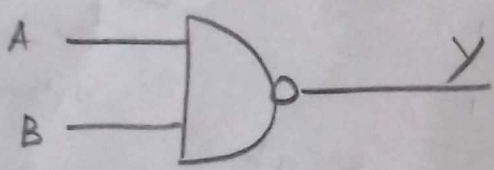
OR



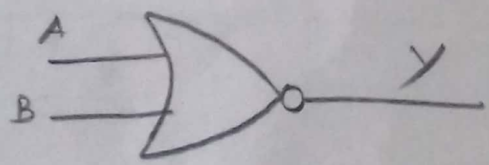
NOT



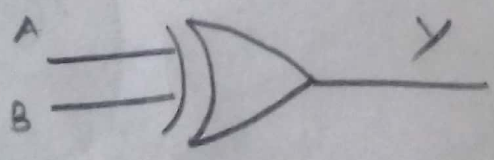
NAND



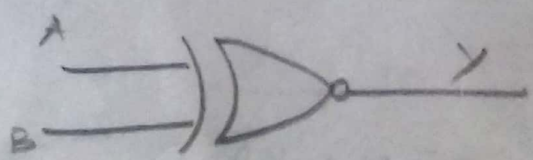
NOR



X OR



XNOR



10.7.18

Logic gates

AND = $Y = A \cdot B$

A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

XOR

A	B	$Y = A \oplus B$
0	0	0
0	1	1
1	0	1
1	1	0

OR

A	B	$Y = A + B$
0	0	0
0	1	1
1	0	1
1	1	1

XNOR

A	B	$Y = A \odot B$
0	0	1
0	1	0
1	0	0
1	1	1

Inverter (NOT)

A	$Y = \overline{A}$
0	1
1	0

NAND

A	B	$Y = \overline{A \cdot B}$
0	0	1
0	1	1
1	0	1
1	1	0

NOR

A	B	$Y = \overline{A + B}$
0	0	1
0	1	0
1	0	0
1	1	0

AND laws:-

$$A.0 = 0$$
$$A.1 = A$$
$$A.A = A$$
$$A.\bar{A} = 0$$

OR laws:-

$$A + 0 = A$$
$$A + 1 = 1$$
$$A + A = A$$
$$A + \bar{A} = 1$$

Double Inversion law:-

$(A')'$ $\bar{\bar{A}} = A$

Commutative laws:-

$$AB = BA$$
$$A+B = B+A$$

Associative laws:-

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

Distributive laws:-

$$A(B+C) = AB+AC$$
$$A+BC = (A+B)(A+C)$$

Absorption law:

$A(A+B) = A$

$A + AB = A$

$A \cdot A + AB$

$= A + A.B$

$= A(1+B)$

$= A$

De Morgan's law:

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

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

Boolean expression.

$Y = A'B + BCD$

individuals are called as literals

Reduction of Boolean Expression.

1. Boolean laws (simple)
2. Karnaugh map. (complicated)
3. Tabulation method. (V. complicated)

I. Use Boolean laws & reduce the expression.

1. $xy + xy'$
2. $xyz + x'y + xyz'$
3. $(a+b+c')(a'b'+c)$

Answers.

1. $xy + xy'$

$x(y+y') = x.1$

$= x$

2. $xyz + x'y + xyz'$

$= xy(z+z') + x'y$

$= xy + x'y$

$= y(x+x')$

$= y.1 = y$

3. $(a+b+c')(a'b'+c)$

$= aa'b' + a'b'b + a'b'c + ac + bc + \underbrace{c'c}_{0}$

$= 0 + 0 + a'b'c' + ac + bc$

$= a'b'c' + ac + bc$ //

4. $(BC' + A'D)(AB' + C'D')$

$= \underbrace{AB'\cancel{B}C'}_{0} + \underbrace{BC'\cancel{C}D'}_{0} + \underbrace{AA'\cancel{D}B'}_{0} + \underbrace{A'D\cancel{C}D'}_{0}$

$= 0$

5. $A'B(D' + C'D) + B(A + A'CD)$

$= A'BD' + A'BC'D + BA + BA'CD$

$= \cancel{A'D(BC'+}$

$= A'BD(C' + C) + A'BD' + BA$

$= A'BD + A'BD' + BA$

$= A'B(D + D') + BA$

$= A'B + BA$

$= B(A + A')$

$= B$

6. $(A'+C)(A'+C')(A+B+C'D)$ $\quad A'(B+C'D)$

4 lala

$= (A'A' + A'C' + CA' + \cancel{CC'})(A+B+C'D)$

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

$= A'(\cancel{A'A} + A'B + A'C'D + C'A + C'B + C'C'D + AC + CB + \cancel{CC'D})$

$= A'(A'B + A'C'D + C'A + C'B + C'C'D + AC + CB)$

$= A'[B(C+C') + A(C+C') + C'C'D + A'C'D + A'B$

$= A'[B + A + C'C'D + A'C'D + A'B]$

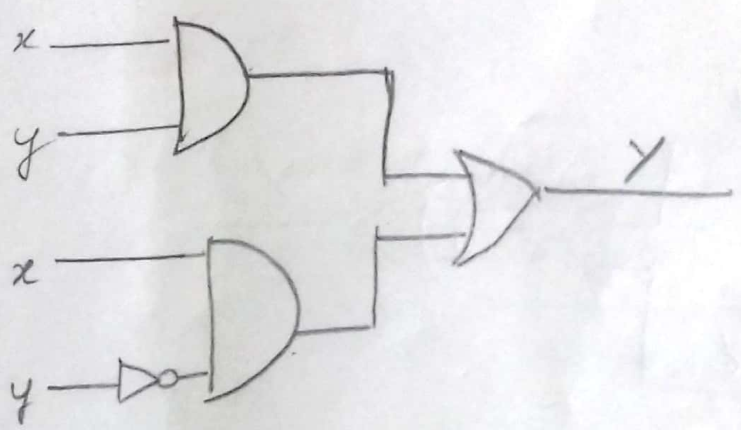
$(A'+CC')(A+B+C'D)$

$= A'(A+B+C'D) = \cancel{A'A} + A'B + A'C'D$

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

Implementation using Logic gates.

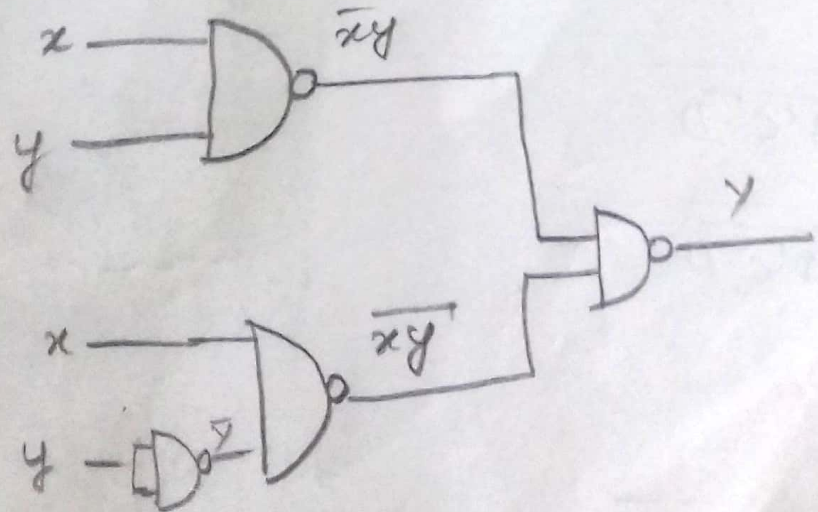
$Y = xy + xy'$



NAND

$Y = \overline{\overline{Y}} = \overline{\overline{xy + xy'}}$

$= \cancel{xc} \quad = \overline{\overline{xy} \cdot \overline{xy'}}$



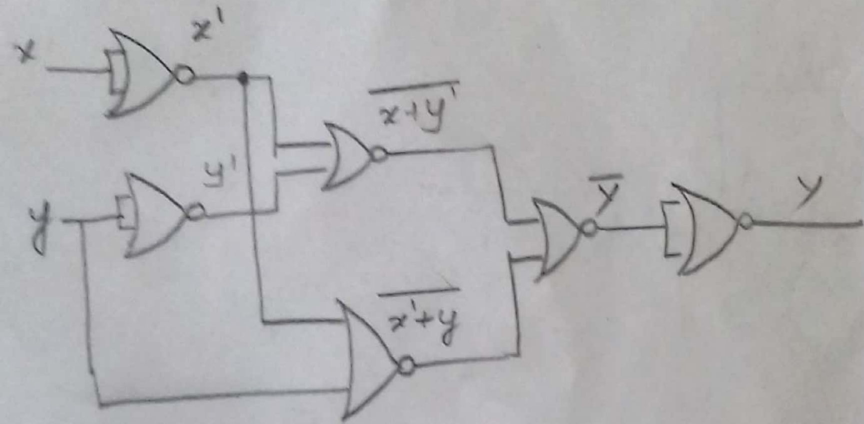
NOR.

[avoid multiplication]

$$y = \overline{\overline{xy} \cdot \overline{xy'}}$$

$$= \overline{(x'+y')(x'+y)}$$

$$= \overline{(x'+y')} + \overline{(x'+y)}$$



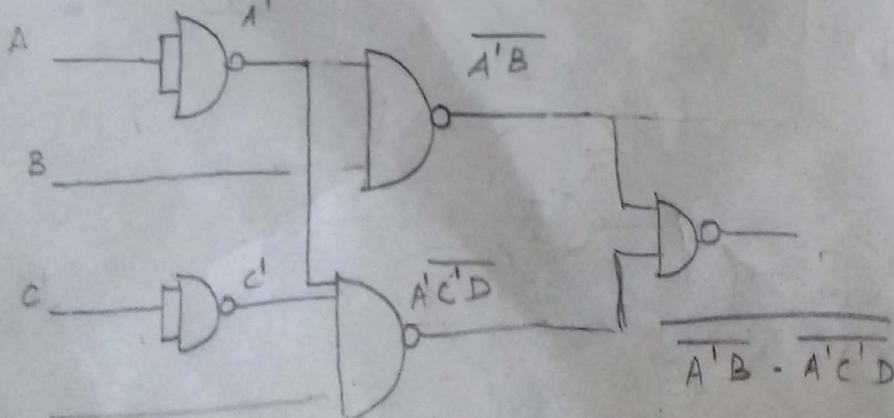
A'(B+C'D) only NAND and only NOR.

⇒ only NAND

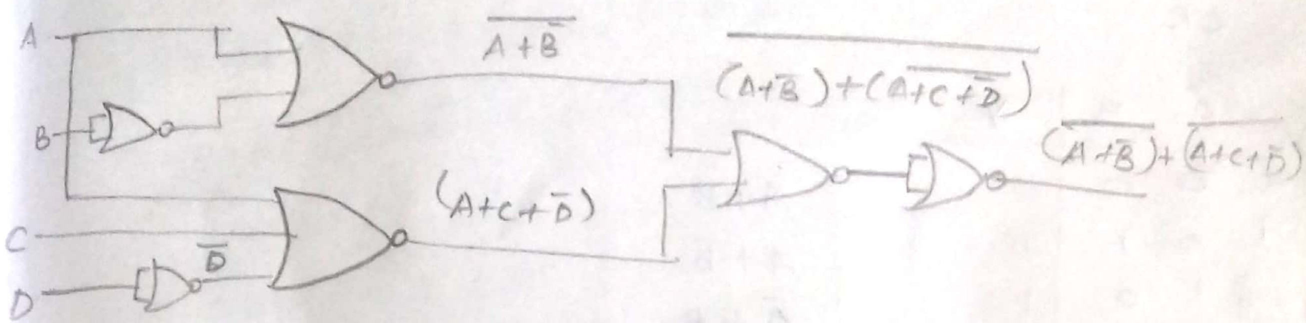
$$y = A'B + A'C'D$$

$$y = \overline{\overline{y}} = \overline{\overline{A'B + A'C'D}}$$

$$= \overline{\overline{A'B} \cdot \overline{A'C'D}}$$



only NOR



$$Y = \overline{A'B \cdot A'C'D}$$

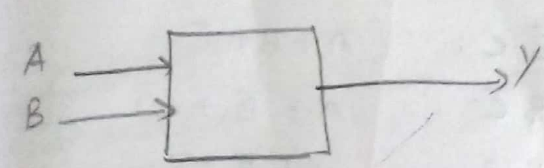
$$Y = \overline{(\bar{\bar{A}} + \bar{B}) \cdot (\bar{A'} + \bar{C'} + \bar{D})}$$

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

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

3.07.18

Maxterms and Minterms.



OR

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

Min term:

$\bar{A}\,\bar{B}$

$\bar{A}\,B$

$A\,\bar{B}$

$A\,B$

0 → complemented ≻ $\bar{A}$ (or) $\bar{B}$

→ canonical form → A (or) B

$$Y = \bar{A}B + A\bar{B} + AB \quad \text{(sum of pdts)}$$

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

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

$$= (B+A)\,\cancel{(B+\bar{B})}\ 1$$

$$= A+B \longrightarrow \text{standard form}$$

→ consider only ones

Maxterms:

Sum of literals/variables

0 → A (un complemented)

1 → $\bar{A}$ complemented (or) $\bar{B}$

OR

	A	B	y	
0	0	0	0	$A+B$
1	0	1	1	$A+\bar{B}$
2	1	0	1	$\bar{A}+B$
3	1	1	1	$\bar{A}+\bar{B}$

$Y = A+B$ (product of sum)

→ consider zeros.

Q)

	A	B	C	y	Min	Max
0	0	0	0	0	$\bar{A}\bar{B}\bar{C}$	$A+B+C$
1	0	0	1	1	$\bar{A}\bar{B}C$	$A+B+\bar{C}$
2	0	1	0	1	$\bar{A}B\bar{C}$	$A+\bar{B}+C$
3	0	1	1	1	$\bar{A}BC$	$A+\bar{B}+\bar{C}$
4	1	0	0	0	$A\bar{B}\bar{C}$	$\bar{A}+B+C$
5	1	0	1	0	$A\bar{B}C$	$\bar{A}+B+\bar{C}$
6	1	1	0	0	$AB\bar{C}$	$\bar{A}+\bar{B}+C$
7	1	1	1	1	ABC	$\bar{A}+\bar{B}+\bar{C}$

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

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

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

$= \cancel{BC + \bar{A}(\bar{B}C}$

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

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

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

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

Max:

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

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

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

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

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

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

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

$\boxed{= BC+\bar{A}B+\bar{A}C.}$ → std form

sum of pdt

Max:

$\boxed{(A+B+C)(\bar{A}+B+C)(\bar{A}+B+\bar{C})(\bar{A}+\bar{B}+C)}$ → canonical [pdt of max terms]

1. Canonical form: → sum of minterms. [all the variables are present] → Product of max terms.
2. standard form → sum of products; → product of sums.

Q.

$Y=(A+A\bar{B})$ → sum of pdt [std form]

missing terms B means take → $B+\bar{B}$

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

$= AB + A\bar{B} + A\bar{B}$

$= AB + A\bar{B}$ → sum of min terms [canonical form]

$= \Sigma(2,3)$

2. $y = BC + \bar{A}B + \bar{A}C$ → sum of pdt

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

$= BCA + BC\bar{A} + \bar{A}BC + \bar{A}B\bar{C} + \bar{A}CB + \bar{A}C\bar{B}$

$= ABC + \bar{A}BC + \bar{A}B\bar{C} + \bar{A}C\bar{B}$

$= \Sigma m(1, 2, 3, 7)$

3. $y = (\bar{A}+\bar{B})(A+B+\bar{C})(\bar{B}+C)$ → pdt of sum

missing variable

$\rightarrow C\bar{C} \Rightarrow 0$

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

$= \overset{6}{(\bar{A}+\bar{B}+C)}\overset{7}{(\bar{A}+\bar{B}+\bar{C})}\overset{1}{(A+B+\bar{C})}\overset{2}{(A+\bar{B}+C)}$

$\overset{6}{(\bar{A}+\bar{B}+C)}$

$= \Pi M(1, 2, 6, 7)$

Q.4. $y = (c'+d)(b+c')$

5. $y = (b+cd)(c+bd)$

4. $y = (c'+d)(b+c')$

$\Rightarrow$ ~~$b\bar{b}+c$~~

$= (\bar{c}+d+b\bar{b})(b+\bar{c}+d\bar{d})$

$= (\bar{c}+d+b)(\bar{c}+d+\bar{b})(b+\bar{c}+d)(b+\bar{c}+\bar{d})$

$= \underbrace{(b+\bar{c}+d)}_{2}\underset{6}{(\bar{b}+\bar{c}+d)}(b+\bar{c}+d)\underset{3}{(b+\bar{c}+\bar{d})}$

$= \Pi m(2, 3, 6)$

$= \Sigma m = (0, 1, 4, 5, 7)$

5. $Y = (b+cd)(c+bd)$

$Y = \cancel{\left(b(c+\bar c)(d+\bar d) + cd(b+\bar b)\right)}.$

$\cancel{\left((b+\bar b)c(d+\bar d) + (c+\bar c)bd\right)}$

$= (b+c)(b+d)(c+b)(c+d)$

$= (b+c+d\bar d)(b+d+c\bar c)(c+b+d\bar d)(c+d+b\bar b)$

$= \overset{0}{(b+c+d)}(b+c+\bar d)\cancel{(b+c+d)}\overset{2}{(b+\bar c+d)}$

$\cancel{(b+c+d)}\ \cancel{(b+c+\bar d)}\ \cancel{(b+c+d)}\overset{4}{(\bar b+c+d)}$

$= \Pi(0,1,2,4)$

$= \Sigma(3,5,6,7) = \Pi(0,1,2,4)$

6. ~~convert~~

6. convert to other canonical form. 0 – 8

(i) $f(x,y,z) = \Sigma(1,3,5) \to \Pi(0,2,4,6,7)$

$f(xyz) = (\underset{1}{\bar x \bar y z} + \underset{3}{\bar x y z} + \underset{5}{x \bar y z})$

(ii) $F(A,B,C,D) = \Pi(3,5,8,11)$

$= \Sigma(0,1,2,4,6,7,9,10,12,13,14,15)$

$\Pi \Leftrightarrow \Sigma$

complemental to each other

Karnaugh Map (K-Map)

Variables-

2

Y

A \ B	$\bar{B}$ (0)	B (1)
(0) $\bar{A}$	$\bar{A}\bar{B}$ 0	$\bar{A}B$ 1
(1) A	$A\bar{B}$ 2	AB 3

00
01
10
11

A → MSB
B → LSB.

⇒ 2 variable K map

Q)

Truth table:

A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

A \ B	0	1
0		1
1	1	1

min term

① ②

STEPS:

[consider adjacent one's]

⇒ only in vertical (or) horizontal way

⇒ consider in powers of 2

(ie) 1, 2, 4, 8, 16, ...

⇒ group the higher no of adjacent one's

① → A

② → B

$Y = A + B$

Q)

1			1
1		1	1

due to folding 2 combination are possible

$F = \bar{C} + AB$

3 variable form.

[adjacent box → 1 bit variation]

AB \ C		

(or)

A \ BC	00	01	11	10
0	$\bar{A}\bar{B}\bar{C}$ 0	$\bar{A}\bar{B}C$ 1	$\bar{A}BC$ 3	$\bar{A}B\bar{C}$ 2
1	$A\bar{B}\bar{C}$ 4	$A\bar{B}C$ 5	ABC 7	$AB\bar{C}$ 6

Q)

	A	B	C	Y
0	0	0	0	0
1	0	0	1	1
2	0	1	0	1
3	0	1	1	1
4	1	0	0	0
5	1	0	1	0
6	1	1	0	0
7	1	1	1	1

A \ BC	$\bar{B}\bar{C}$ 00	$\bar{B}C$ 01	BC 11	$B\bar{C}$ 10
0	0	1 (1)	1 (3)	1 (2)
1	4	5	1 (7)	6

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

1. $F(x,y,z) = \Sigma(3,4,5,7)$

A \ BC	$\bar{B}\bar{C}$ 00	$\bar{B}C$ 01	BC 11	$B\bar{C}$ 10
$\bar{A}$ 0	0	1	1 (3)	2
A 1	1 (4)	1 (5)	1 (7)	6

$Y = BC + \cancel{AC} + A\bar{B} + \cancel{AC}$

Ac

including or excluding gives the same value

$\boxed{5 \quad 7}$ → redundant term [not necessary]

4 Variable Map — 16 square boxes.

AB \ CD	$\bar{C}\bar{D}$ 00	$\bar{C}D$ 01	CD 11	$C\bar{D}$ 10
$\bar{A}\bar{B}$ 00	1 $_{0}$	$_{1}$	$_{3}$	1 $_{2}$
$\bar{A}B$ 01	1 $_{4}$	$_{5}$	1 $_{7}$	$_{6}$
AB 11	$_{12}$	$_{13}$	1 $_{15}$	$_{14}$
$A\bar{B}$ 10	1 $_{8}$	$_{9}$	$_{11}$	1 $_{10}$

0 0 1 1 $\bar{A}\bar{B}$

0 1 0 1 $\bar{A}B$

0 1 0 0 AB

0 0 1 1 $A\bar{B}$

1010

$$Y = \bar{B}\bar{D} + \bar{A}\bar{C}\bar{D} + BCD.$$

17.07.18

Reduce the boolean expression using k-map.

1. $F(A,B,C,D) = \Sigma(0,1,3,5,7,8,9,11,13,14,15)$

AB \ CD	$\bar{C}\bar{D}$ 00	$\bar{C}D$ 01	CD 11	$C\bar{D}$ 10
00	1 $_{0}$	1 $_{1}$	1 $_{3}$	$_{2}$
01	$_{4}$	1 $_{5}$	1 $_{7}$	$_{6}$
11	$_{12}$	1 $_{13}$	1 $_{15}$	1 $_{14}$
10	1 $_{8}$	1 $_{9}$	1 $_{11}$	$_{10}$

$$Y = \bar{B}\bar{C} + D + ABC$$

2. $F(A,B,C,D) = \Pi(5,6,7,9,10,11,13,15)$

$= \Sigma(0,1,2,3,4,8,12,14)$

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

0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7
1000	8
1001	9
1010	10
1011	11

$\cancel{= \bar{A}\bar{B} + \bar{C}\bar{D} + AB\bar{D}}$

$\cancel{= BD + AD + A\bar{B}C + \bar{A}BC}$

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

$\cdot F(w,x,y,z) = w\bar{x}y + \bar{x}\bar{y}\bar{z} + y\bar{z} + \bar{w}\bar{z}$

3. $F(w,x,y,z) = w\bar{x}y + \bar{x}\bar{y}\bar{z} + y\bar{z} + \bar{w}\bar{z}$

1011
$1100 \longrightarrow 12$
$1101 \longrightarrow 13$
$1110 \longrightarrow 14$
$1111 \longrightarrow 15$

	y,z	$\bar{y}\bar{z}$ 00	$\bar{y}z$ 01	yz 11	$y\bar{z}$ 10
$\bar{w}\bar{x}$	w,x 00	1 (0)	(1)	(3)	1 (2)
$\bar{w}x$	01	1 (4)	(5)	(7)	1 (6)
wx	11	(12)	(13)	(15)	1 (14)
$w\bar{x}$	10	1 (8)	(9)	1 (11)	1 (10)

~~$y = \bar{w}$~~

~~$y = y\bar{z} + \bar{w}\bar{z} + w\bar{x}y$~~

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

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

$= w\bar{x}yz + w\bar{x}y\bar{z} + \bar{x}\bar{y}\bar{z}w + \bar{x}\bar{y}\bar{z}\bar{w} + (xw + x\bar{w} + \bar{x}w + \bar{x}\bar{w})y\bar{z} + \bar{w}\bar{z}(xy + x\bar{y} + \bar{x}y + \bar{x}\bar{y})$

$= \underline{w\bar{x}yz} + w\bar{x}y\bar{z} + \bar{x}\bar{y}\bar{z}w + \bar{x}\bar{y}\bar{z}\bar{w} + xwy\bar{z} + x\bar{w}y\bar{z} + \bar{x}wy\bar{z} + \bar{x}\bar{w}y\bar{z} + \bar{w}\bar{z}xy + \bar{w}\bar{z}x\bar{y} + \bar{w}\bar{z}\bar{x}y + \bar{w}\bar{z}\bar{x}\bar{y}$

11, 5, 8, 0, 14, 6, 10, 2, 6, 4, 2, 0

(0, 2, 4, 6, 6, 8, 10, 11, 14)

Scanned by CamScanner

4. $F = \Sigma(1,2,3,5,6,7,9,11,12,13,15)$

AB \ CD	$\bar{C}\bar{D}$ 00	$\bar{C}D$ 01	CD 11	$C\bar{D}$ 10
$\bar{A}\bar{B}$ 00	(0)	1 (1)	1 (3)	1 (2)
$\bar{A}B$ 01	(4)	1 (5)	1 (7)	1 (6)
AB 11	1 (12)	1 (13)	1 (15)	(14)
$A\bar{B}$ 10	(8)	1 (9)	(11)	(10)

$y = D + \bar{A}C + AB\bar{C}$

20/08/18

K-map with dont care. 'X'.

1. $F(\quad) = \Sigma m(2,5,7,9,11,12,14) + \Sigma d(3,4,6)$

dont care 'X'

X → may be 1 (or) 0

AB \ CD	$\bar{C}\bar{D}$ 00	$\bar{C}D$ 01	CD 11	$C\bar{D}$ 10
$\bar{A}\bar{B}$ 00	(0)	(1)	X (3)	1 (2)
$\bar{A}B$ 01	X (4)	1 (5)	1 (7)	X (6)
AB 11	1 (12)	(13)	(15)	1 (14)
$A\bar{B}$ 10	(8)	1 (9)	1 (11)	(10)

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

2.Q)

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

3Q. $F(ABCD) = \Sigma(0,6,8,13,14)$ -

$D(ABCD) = \Sigma(2,4,10)$

2Q). $F = \bar{x}yz + x\bar{y}\bar{z} + x\bar{y}z$

x \ yz	$\bar{y}\bar{z}$ 00	$\bar{y}z$ 01	yz 11	$y\bar{z}$ 10
$\bar{x}$ 0	0	1	1 3	2
x 1	1 4	1 5	7	6

$Y = x\bar{y} + \bar{x}yz$

3Q)

AB \ CD	$\bar{C}\bar{D}$ 00	$\bar{C}D$ 01	CD 11	$C\bar{D}$ 10
$\bar{A}\bar{B}$ 00	1 0	1	3	X 2
$\bar{A}B$ 01	X 4	5	7	1 6
AB 11	12	1 13	15	1 14
$A\bar{B}$ 10	1 8	9	11	X 10

~~15, 18~~

No need to map all x.

~~$Y = \bar{A}\bar{C}\bar{D} + A.B\bar{C}D + \bar{B}\bar{C}\bar{D}\ \bar{B}\bar{D} + \bar{A}\bar{D} + C\bar{D}$~~

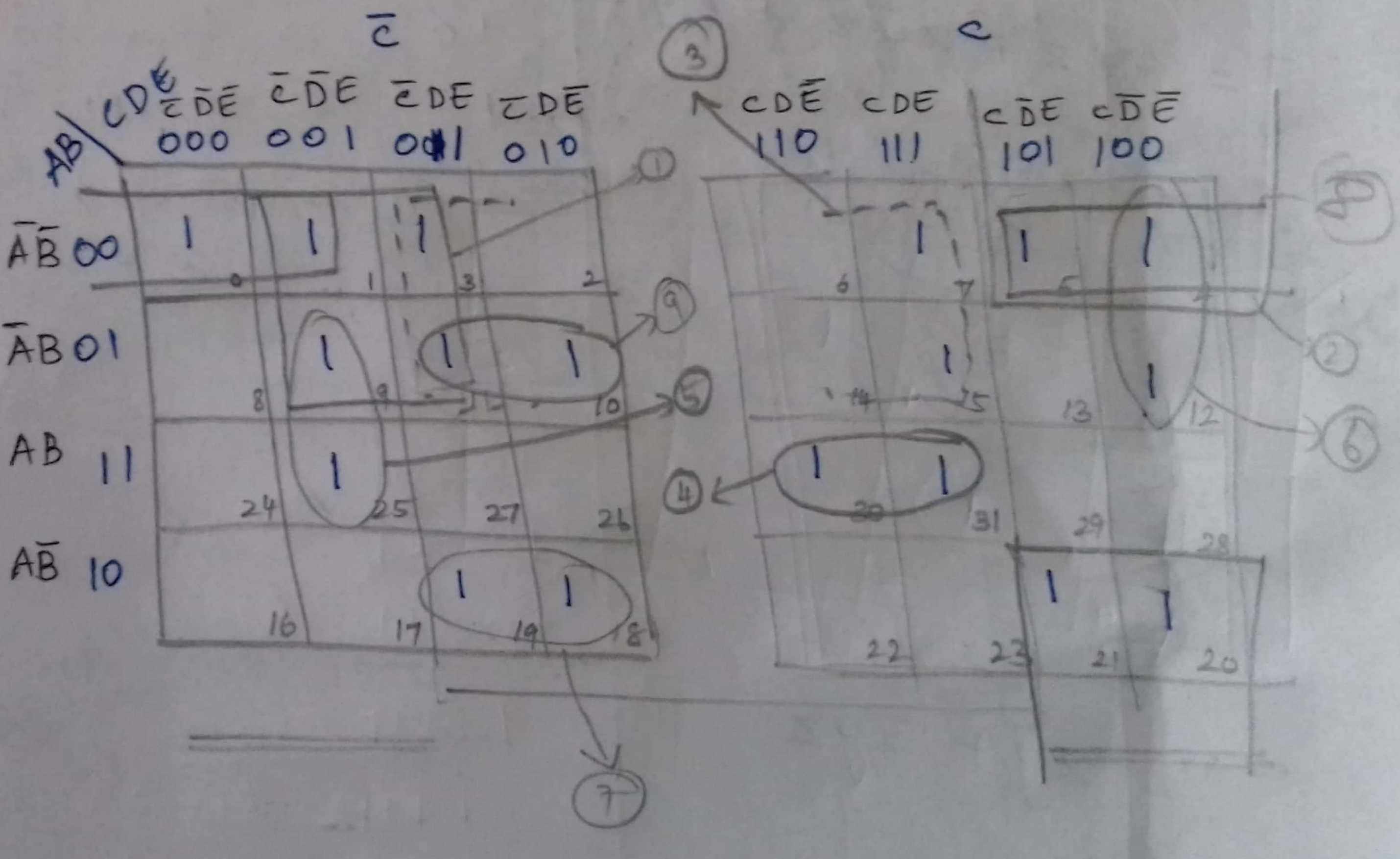
$Y = AB\bar{C}D + \bar{B}\bar{D} + \cancel{\bar{A}\bar{D}} + C\bar{D}$

Scanned by CamScanner

5 VARIABLE MAP. (0-31)

Q.

$$F = \Sigma(0,1,3,5,7,9,10,11,12,15,18,19,20,21,25,30,31)$$



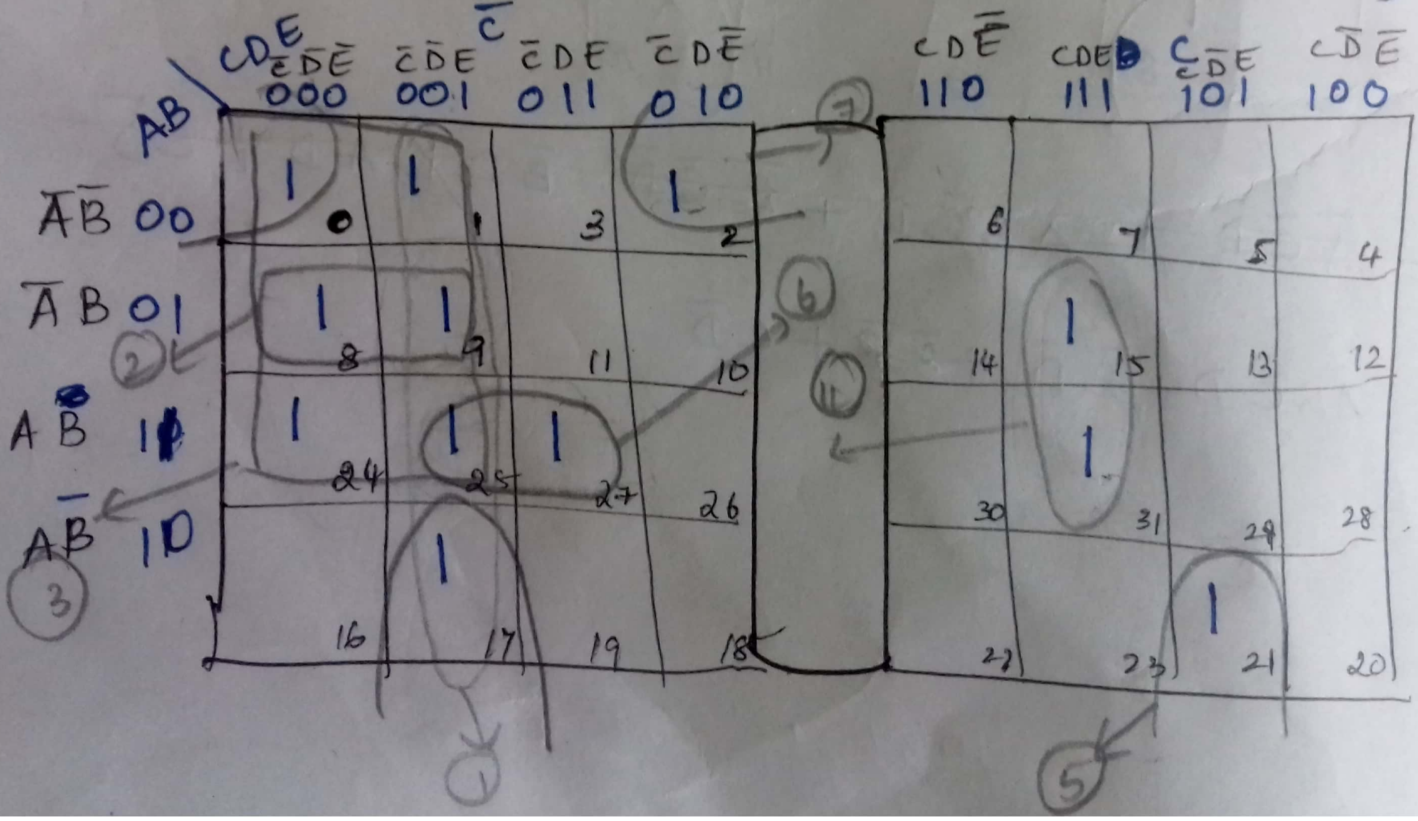
$$F = \bar{A}\bar{C}E + \bar{A}\bar{B}\bar{D} + \bar{A}DE + ABCD + B\bar{C}\bar{D}E + \bar{A}C\bar{D}\bar{E} + A\bar{B}\bar{C}D + \bar{B}C\bar{D} + \bar{A}B\bar{C}D$$

TABULATION METHOD

(Queine Mcklurkey Method)

5 Variable

Q). $F = \Sigma(0,1,2,8,9,15,17,21,24,25,27,31)$



$F = \cancel{\bar{C}\bar{D}\bar{E}} + \bar{A}\bar{C}\bar{D} + B\bar{C}\bar{D} + BCDE + A\bar{B}\bar{D}E + AB\bar{C}E + \bar{A}\bar{B}\bar{C}\bar{E}$

TABULATION METHOD

(Quine Mcklukey Method)

[consider the highest number
→ convert into binary
→ group with no of ones
→ dont care symbol (—)]

Q.

Total 6 groups

	A	B	C	D	E	
0	0	0	0	0	0	✓
1	0	0	0	0	1	✓
2	0	0	0	1	0	✓
8	0	1	0	0	0	✓
9	0	1	0	0	1	✓
17	1	0	0	0	1	✓
24	1	1	0	0	0	✓
21	1	0	1	0	1	
25	1	1	0	0	1	✓
15	0	1	1	1	1	✓
27	1	1	0	1	1	✓
31	1	1	1	1	1	✓

Iteration -1

(0,1) 0000–
(0,2) 000–0
(0,8) 0–000
(1,9) 0–001
(1,17) –0001
(8,9) 0100–
(8,24) –1000
(9,25) –1001
(17,21) 10–01
(17,25) 1–001
(24,25) 1100–
(25,27) 110–1
(15,31) –1111
(27,31) 11–11

Iteration -2

Iteration - 1.

(0,1)	0000 -	✓
	A B C D E	
(0, 2)	000 - 0	
(0, 8)	0 - 000	✓
(1, 9)	0 - 001	✓
(1, 17)	- 0001	✓
(8, 9)	0100 -	✓
(8, 24)	- 1000	
(9, 25)	- 1001	✓
(17, 21)	10 - 01	
(17, 25)	1 - 001	✓
(24, 25)	1100 -	
(25, 27)	110 - 1	
(15, 31)	- 1111	
(27, 31)	11 - 11	

Iteration 2

(0, 1, 8, 9)	0 - 00 -
~~(0, 8, 1, 9)~~	~~0 - 00 -~~
(1, 9, 17, 25)	- - 001
~~(1, 17, 9, 25)~~	~~- - 001~~
(8, 9, 24, 25)	- 100 -
~~(8, 24, 9, 25)~~	~~- 100 -~~

Prime Implicints)

(0, 2) $\bar{A}\,\bar{B}\,\bar{C}\,\bar{E}$

(17, 21) A

(25, 27)

(15, 31)

(27, 31)

(0, 1, 8, 9)

(1, 9, 17, 25)

(8, 9, 24, 25)