URBAN EDGE 01/12/21

Chapter : 02

Number System And Boolean Algebra

⇒ **Number System :-**

A comp can understand the positional N.system where there are only a few symbols → Digits.

These symbols represent different values depending on the position they occupy in the no..

* The value of each digit in a no determined using –

a) The digit

b) The position of the digit in the no.

c) The base of N.system.

1) **Decimal N.S :-** (10) (0–9)

* Each position represent a specific power of the base (10).

* eg → 1234 4 units

1000 + 200 + 30 + 4.

$(1\times1000)+(2\times100)+(3\times10)+(4\times1)$ (or)

$(1\times10^3)+(2\times10^2)+(3\times10^1)+(4\times10^0)$

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2) **Binary N.S :-** (Base → 2) (0, 1)

eg → 10101_2

$((1\times2^4)+(0\times2^3)+(1\times2^2)+(0\times2^1)+(1\times2^0))_{10}$

$=(16+0+4+0+1)_{10} = 21_{10}$

3) **Octal N.S :-** (Base → 8) (0–7)

* Each digit corresponds to the power of 8.

* eg → 12570_8

$((1\times8^4)+(2\times8^3)+(5\times8^2)+(7\times8^1)+(0\times8^0))_{10}$

$=(4096+1024+320+56+0)_{10}$

$=5496_{10}$

4) **Hexa decimal N.S :-** (Base – 16) (0–15)

* 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F.
(A = 10, B = 11, C = 12, D = 13, E = 14, F = 15)

A = 10 .... F = 15.

* eg → $19FDE_{16}$

$((1\times16^4)+(9\times16^3)+(F\times16^2)+(D\times16^1)+(E\times16^0))_{10}$

F = 15, D = 13, E = 14

B + O + H = D.

$= (65536 + 36864 + 3840 + 208 + 14)_{10}$

$= 106462_{10}$

⇒ Conversions :-

1) Binary to Decimal =

(right → Left)

1) 100111_2 $= [(1\times2^5)+(0\times2^4)+(0\times2^3)+(1\times2^2)+(1\times2^1)+(1\times2^0)]_{10}$

$= [32 + 0 + 0 + 4 + 2 + 1]_{10}$

$= 39_{10}$

$100111_2 = 39_{10}$

2) 10101_2

$= [(1\times2^4)+(0\times2^3)+(1\times2^2)+(0\times2^1)+(1\times2^0)]_{10}$

$= [16 + 0 + 4 + 0 + 1]_{10}$

$10101_2 = 21_{10}$

3) 10101.101_2

$= (1\times2^4)+(0\times2^3)+(1\times2^2)+(0\times2^1)+(1\times2^0).(1\times2^{-1})+(0\times2^{-2})+(1\times2^{-3})$

$= 16 + 0 + 4 + 0 + 1 . 0.5 + 0 + 0.125$

$= 21.625$

4) 1111_2 $= (1\times2^3)+(1\times2^2)+(1\times2^1)+(1\times2^0)$

$= 8 + 4 + 2 + 1 = 15_{10}$

5) 101_2 $= (1\times2^2)+(0\times2^1)+(1\times2^0)$

$= 4 + 0 + 1 = 5_{10}$

6) 111_2 $= (1\times2^2)+(1\times2^1)+(1\times2^0)$

$= 4 + 2 + 1 = 7_{10}$

(MSD = Most S. digit)

→ Bits (b) :-

1 0 0 1 0 1 1 0

MSB (most significant bit) LSB (Least S. bit)

→ Bytes & Nibbles :-

Byte (B) = 8 bits

Nibbles (N) = 4 bits

eg → $\overbrace{1001\underbrace{0110}_{N}}^{\text{byte}}$

$\underbrace{CE}_{MSB}$ BF 9 A $\underbrace{D7}_{LSB}$

* $2^{10} = 1024 = 1$ kB
* $2^{20} = 1024 \times 1024 = 1$ MB
* $2^{30} = 1024 \times 1024 \times 1024 = 1$ GB.

1) $(1101)_2 = (1\times2^3)+(1\times2^2)+(0\times2^1)+(1\times2^0)$
$= 8 + 4 + 0 + 1 = (13)_{10}$

2) $(5217)_8 = (5\times8^3)+(2\times8^2)+(1\times8^1)+(7\times8^0)$
$= 2560 + 128 + 8 + 7$
$= (2703)_{10}$

3) $(47)_8 = (4\times8^1)+(7\times8^0)$
$= 32 + 7 = \cancel{(40)_{10}}$ $(39)_{10}$

4) $(1011.101)_2 =$
$(1\times2^3)+(0\times2^2)+(1\times2^1)+(1\times2^0)+(1\times2^{-1})+(0\times2^{-2})+(1\times2^{-3})$
$= 8+0+2+1+0.5+0+0.125$
$= (11.625)_{10}$

5) $(22.34)_8 =$
$(2\times8^1)+(2\times8^0).(3\times8^{-1})+(4\times8^{-2})$
$= 16 + 2 . 0.375 + 0.0625$
$= (18.4375)_{10}$

→ Hexadecimal to decimal :-

1) $(1ACF)_{16}$ A = 10   F = 15   C = 12
$(1\times16^3)+(10\times16^2)+(12\times16^1)+(15\times16^0)$
$= \cancel{20480}\ 4096 + 2560 + 192 + 15$
$= \cancel{(23247)_{10}} = (6863)_{10}$

2) $(81.21)_{16} = (8\times16^1)+(1\times16^0).(2\times16^{-1})+(1\times16^{-2})$
$= 128 + 1 . 0.125 + 3.90625$
$= (129.1289)_{10}$

→ Decimal to Binary :-

1) $(139)_{10}$

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$2 \,|\, 139$
$2 \,|\, 69 - 1$
$2 \,|\, 34 - 1$
$2 \,|\, 17 - 0$
$2 \,|\, 8 - 1$
$2 \,|\, 4 - 0$
$2 \,|\, 2 - 0$
$1 - 0$

(69+69=138) remainder 1

$(139)_{10} = (10001011)_2$

2) $(250)_{10}$

$2 \,|\, 250$
$2 \,|\, 125 - 0$
$2 \,|\, 62 - 1$
$2 \,|\, 31 - 0$
$2 \,|\, 15 - 1$
$2 \,|\, 7 - 1$
$2 \,|\, 3 - 1$
$1 - 1$

$(250)_{10} = (11111010)_2$

→ **Decimal to octal :-**

1) $(210)_{10}$

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$8 \,|\, 210$
$8 \,|\, 26 - 2$
$3 - 2$

$(210)_{10} = (322)_8$

2) $(250)_{10}$

$8 \,|\, 250$
$8 \,|\, 31 - 2$
$3 - 7$

(248+2)
3×8+7

$(250)_{10} = (372)_8$

→ **Decimal to Hexadecimal :-**

1) $(250)_{10}$

$16 \,|\, 250$
$15 - 10 \rightarrow A$
$15 \rightarrow F$

$= (FA)_{16}$

2) $(2479.859)_{10}$

$16 \,|\, 2479$
$16 \,|\, 154 - 15 \rightarrow F$
$9 - 10 \rightarrow A$

(9 A F)

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(5 points)

$16 \,|\, 859$
$16 \,|\, 53$ — 11
3 — 5

~~3 5 B~~

$16 \times 0.859 = 13$	D	(13.744)
$16 \times 0.744 = 11$	B	(11.904)
$16 \times 0.904 = 14$	E	(14.464)
$16 \times 0.464 = 7$	7	(7.424)
$16 \times 0.424 = 6$	6	(Hex → 6)	(6.784)

$(9AF.DBE76)_{16}$

→ Decimal to Binary :-

1) $(139.4375)_{10}$

$(10001011.0111)_2$

$2 \times 0.4375 = 0.8750$ — 0
$2 \times 0.8750 = 1.750$ — 1
$2 \times 0.750 = 1.50$ — 1
$2 \times 0.50 = 1.0$ — 1

2 | 139
2 | 69 — 1
2 | 34 — 1
2 | 17 — 0
2 | 8 — 1
2 | 4 — 0
2 | 2 — 0
1 — 0

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→ Decimal to octal :-

1) $(0.4375)_{10}$ $\quad 8 \times 0.4375 = 3.5$ — 3
$8 \times 0.5 = 4.0$ — 4

$(0.34)_{10}$

2) $(19.11)_{10}$ $\quad 8 \,|\, 19$
2 — 3

$(23.07024)_8$

$8 \times 0.11 = 0.88$ — 0
$8 \times 0.88 = 7.04$ — 7
$8 \times 0.04 = 0.32$ — 0
$8 \times 0.32 = 2.56$ — 2
$8 \times 0.56 = 4.48$ — 4

→ Decimal to Hexadecimal :-

1) $(0.4375)_{10}$ $\quad 16 \times 0.4375 = 7.0$ — 7

$= (0.7)_{16}$

→ D — Binary :-

2) $(0.782)_{10}$
3) $(22.5)_{10}$

2.v) $(0.782)_{10}$

$2 \times 0.782 = 1.564$ — 1
$2 \times 0.564 = 1.128$ — 1
$2 \times 0.128 = 0.256$ — 0
$2 \times 0.256 = 0.512$ — 0
$2 \times 0.512 = 1.024$ — 1

$= (0.11001)_2$

3.A) $(22.5)_{10}$

2	22	
2	11	— 0
2	5	— 1
2	2	— 1
	1	— 0

$2 \times 0.5 = 1.0$ — 1

$(10110.1)_2$

→ Binary to octal :-

1) $(10111100.10101)_2$

101|111|100 . 101|010

$(5\ 7\ 4\ .\ 5\ 2)_8$

(octal → 0–7)

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

2) $(11100.1001)_2$

011|100 . 100|100

$= (34.44)_8$

3) $(111111)_2$

111|111

$= (77)_8$

→ Octal to Binary :-

1) $(55.126)_8 = (101\,101.001\,010\,110)_2$

→ Binary to Hexadecimal :-

	8 4 2 1
0 —	0 0 0 0
1 —	0 0 0 1
2 —	0 0 1 0
3 —	0 0 1 1
4 —	0 1 0 0
5 —	0 1 0 1
6 —	0 1 1 0
7 —	0 1 1 1
8 —	1 0 0 0
9 —	1 0 0 1
10 —	1 0 1 0
11 —	1 0 1 1
12 —	1 1 0 0
13 —	1 1 0 1
14 —	1 1 1 0
15 —	1 1 1 1

1) $(110101111 \cdot 1101)_2$

$\underbrace{0001}\underbrace{1010}\underbrace{1111} \cdot \underbrace{1101}$

1 10 15 . 13

$= (1AF.D)_{16}$

A = 10
B = 11
C = 12
D = 13
E = 14
F = 15

→ 2) Hexadecimal to Binary :-

1) $(6C.3B)_{16}$

C = 12
B = 11

$(6\ 12\ .\ 3\ 11)_{16}$

$= (0110\ 1100 \cdot 0011\ 1011)_2$

2) $(5A.B)_{16}$

$(5\ 10.\ 11)_{16} = (0101\ 1010.1011)_2$

→ Binary Arithmetic :-

* Binary Addition :-

A	B	A+B	Carry
0	0	0	0
1	0	1	0
0	1	1	0
1	1	0	1

(Binary of 2 → 0,1)

Q 1) 0110 +
0111
1101

(3) 1101
01101
10010

2) 10011 +
1001
11100

⇒ Binary Subtraction :-

A	B	A-B	Borrow
0	0	0	0
1	0	1	0
0	1	1	1
1	1	0	0

Q 10101 -
01110
~~+0001~~
00111

10101
01110
00111

10101
01110
00111

2) 1101 -
0101
1000

(3) 11010 -
01100
01110

4) 10101 -
01110
00111

$(00111)_2$

00111

⇒ 1's Complement :-

0 → 1
1 → 0

Binary No.	1's Complement.
0101	1010
1001	0110
1101	0010
0001	1110

→ 1's Complement Subtraction :-

1) 110101 - → minued
100101 → 1's complemnt subtrahend

take 1's complemnt of 100101 → 011010
then add..

110101 +
011010
1|001111 +
1 → End around carry
(010000)

2) 101011 −
111001

1's complement of 111001 → 000110

101011 +
000110
110001

Here there is no endaround carry (i.e) it is a −ve No.
So to obtain the result find its 1's complement & give −ve sign
110001 → −(001110)

The following points should be noted down when we do 1's compliment subtraction.

1. write the 1st No. (Minuend) as such.
2. write the 1's complement of 2nd No. (Subtrahend).
3. Add the 2 No.
4. The carry that arises from the addition is said to be 'end around carry'.
5. End around carry should be added with the sum to get the result.
6. If there is no end around carry find 1's complement of the sum & put −ve sign before the result as the result is −ve.

1) 1111 −
1010

1's complement of 1010 → 0101

1111 +
0101
1 0100 +
1
0101

2) 1000 −
0101

0101 → 1010

1000 +
1010
1 0010 +
1
0011

3) 1000 −
1010

1010 → 0101

1000 +
0101
10101

1101 → $\overline{0010}$

⇒ 2's Complement of Subtraction :-

Binary No	1's complement	2's Complement
0101	1010	1011
1001	0110	0111
1101	0010	0011
0001	1110	1111

~~110 110 −~~
~~101 010~~

~~110 110 +~~
~~101 10~~

Steps
* write the 1st no as such.
* write down 2's (C) of 2nd no.
* Add the 2 no.
* If there is a carry, discard it & the remaining part (sum) will be the result (+ve)
* If there is no carry, find 2's (C) of the sum & put −ve sign before the result as the result as −ve.

Q
i) 110 110 → 6 no
10 110 → 5 no.. so add 0. ⇒ 010110

1's (C) of 010110 → 101001
2's (C) → 101001 +
1
101010

110 110 +
101 010
carry → 1 100000

⇒ 100000

Discard 1.

2) 10110 −
11010

1's (c) of 11010 → 00101
2's (c) → 00101 +
1
00110

10110 +
00110
11100

~~11100~~

No carry, so find 2's (c) of 11100.

00011 +
1
−00100 (cancel 0)

⟹ −100

⟹ Binary Multiplication :-

A	B	Multiplication
0	0	0
0	1	0
1	0	0
1	1	1

1) 01010 ×
01110
00000
01010
01010
0000
0111100

(2) 1101 ×
1110
0000
1101
1101
1101
10110110

⟹ Binary Division :-

1) ~~101) 11001 (~~
~~101~~
~~101~~
~~101~~
~~10~~

101) 11001 (00101
101
00101
101
0

2) 101) 101101 (001001
101
101
101
0

×

101) 101101 (001001
101
101
101
110

✓

3)

```
         011110
10 | 1111100
     10
     11
     10
     11
     10
     11
     10
     10
     10
     00
      0
```

(4).

```
        110
11 | 10010
     11
     011
      11
      00
       0
```

~~110~~

```
       110
11 | 10010
     11
     011
      11
      000
        0
```

positive is imp

5)

```
      11.1101
11 | 1011.11
     11
     101
      11
      101
       11
       101
        11
        100
         11
        0100
```

6)

```
          10.0111
1100 | 1110 1.01
       1100
        10101
        1100
        10010
         1100
         01100
          1100
          0000
```

→ Octal Arithmetic :- (octal → 0-7, 10-15)

+	0	1	2	3	4	5	6	7
0	0	1	2	3	4	5	6	7
1	1	2	3	4	5	6	7	10
2	2	3	4	5	6	7	10	11
3	3	4	5	6	7	10	11	12
4	4	5	6	7	10	11	12	13
5	5	6	7	10	11	12	13	14
6	6	7	10	11	12	13	14	15
7	7	10	11	12	13	14	15	16

8 → 10
9 → 11
10 → 12
11 → 13
12 → 14
13 → 15
14 → 16

Verified

$7 \to 7$
$8 \to 10$
$9 \to 11$

Q ⇒ octal Addition :-

1) $(162)_8 + (537)_8 = (721)_8$

$$\begin{array}{r} 162+ \\ 537 \\ \hline 721 \end{array}$$

2) $(456)_8 + (123)_8 = (601)_8$

$$\begin{array}{r} 456+ \\ 123 \\ \hline 601 \end{array}$$

3)
$$\begin{array}{r} 25.27+ \\ 13.2 \\ \hline 40.47 \end{array}$$

→ octal Subtraction :-

1)
$$\begin{array}{r} 456- \\ 173 \\ \hline 263 \end{array}$$

octal → 8

4-ൽ നിന്ന് 1 borrow
കൊടുക്കുക, അത് 1 → 8 ആകും

2)
$$\begin{array}{r} 256- \\ 245 \\ \hline 11 \end{array}$$

⇒ Hexadecimal Arithmetic :-

+	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
1	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F	10
2	2	3	4	5	6	7	8	9	A	B	C	D	E	F	10	11
3	3	4	5	6	7	8	9	A	B	C	D	E	F	10	11	12
4	4	5	6	7	8	9	A	B	C	D	E	F	10	11	12	13
5	5	6	7	8	9	A	B	C	D	E	F	10	11	12	13	14
6	6	7	8	9	A	B	C	D	E	F	10	11	12	13	14	15
7	7	8	9	A	B	C	D	E	F	10	11	12	13	14	15	16
8	8	9	A	B	C	D	E	F	10	11	12	13	14	15	16	17
9	9	A	B	C	D	E	F	10	11	12	13	14	15	16	17	18
A	A	B	C	D	E	F	10	11	12	13	14	15	16	17	18	19
B	B	C	D	E	F	10	11	12	13	14	15	16	17	18	19	1A
C	C	D	E	F	10	11	12	13	14	15	16	17	18	19	1A	1B
D	D	E	F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C
E	E	F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D
F	F	10	11	12	13	14	15	16	17	18	19	1A	1B	1C	1D	1E

10 → A	16 → 10	22 → 16
11 → B	17 → 11	23 → 17
12 → C	18 → 12	24 → 18
13 → D	19 → 13	25 → 19
14 → E	20 → 14	26 → 1A
15 → F	21 → 15	27 → 1B
		28 → 1C
		29 → 1D
		30 → 1E

Q

1)
$$\begin{array}{r} {}^{1\,1}\\ B\,A\,3\;+ \\ 5\,D\,E \\ \hline 11\,8\,1 \end{array}$$

$3 + E = 17 \rightarrow 11$

$A + D = 10 + 13 = 23 \rightarrow 17 + 1 = 18$

$B + 5 = 11 + 5 = \cancel{16+1=17}$

$= 16 \rightarrow 10 + 1 = 11$

2)
$$\begin{array}{r} {}^{1}\\ 4\,A\,6\;+ \\ 1\,B\,3 \\ \hline 6\,5\,9 \end{array}$$

$A + B \rightarrow 10 + 11 = 21 \rightarrow 15$

Decimal ~~-~~ BCD Conversion :-

The method of converting a decimal No. to binary no. is by repeated division and the answer

* Convert this no. to when decimal → eg ⇒ $(25)_{10} \rightarrow (\;)_2$

Here $2 \rightarrow 0010$

$5 \rightarrow 0101$

$\Rightarrow (00100101)_2$

will be the combination of 0 & 1

eg = $(25)_{10} \rightarrow$ binary

$\Rightarrow (0010\ 0101)_{2(BCD)}$

$$\begin{array}{r|l} 2 & 25 - 1 \\ 2 & 12 - 0 \\ 2 & 6 - 0 \\ 2 & 3 - 1 \\ 2 & 1 - 1 \\ & 1 \end{array}$$

$(.75)_{10} \rightarrow 0.75 \times 2 = 1.50 - 1$

$.50 \times 2 = 1.00 - 1$

$= (.11)_2$

$(0.625)_{10} \rightarrow 0.625 \times 2 = 1.25 - 1$

$0.25 \times 2 = 0.5 - 0$

$0.5 \times 2 = 1 - 1$

$(.101)_2$

~~$(1.5.25)_{10}$ →~~ ~~$15\ 25 \times 2$~~

⇒ BCD to Decimal Conversion :-

A binary no. can be converted into its decimal equivalent by summing up the product of each bit i.e. its weight.

eg = $(11011)_2 \rightarrow 1\times2^4 + 1\times2^3 + 0\times2^2 + 1\times2^1 \times 1\times2^0$

$= \cancel{16+8}+2+1 = (27)_{10}$

2) $(.101)_2 = 2^{-1}\times1 + 2^{-2}\times0 + 2^{-3}\times1$

$= 0.5 + 0 + 0.125$

$= (0.625)_{10}$

3) $(1010.11)_2 = 1\times2^3 + 0\times2^2 + 1\times2^1 + 0\times2^0 + 1\times2^{-1} + 1\times2^{-2}$

$= 8 + 0 + 2 + 0 + 0.5 + 0.25$

$= (10.75)_{10}$

⇒ ASCII code :-

(American Standard code for Info. Interchange)

It associates an integer value for each symbol in the character set like letters, digits, punctuation marks, spl charter, etc.

⇒ UNICODE :-

Universal character encoding that assigns code to every character & symbol in every lang in the world.

* (U) is the only encoding standard that ensures you can retrieve / combine data using any combination of lang.

⇒ Gray code :-

XOR.

A	B	XOR
0	0	0
0	1	1
1	0	0
1	1	0

	Binary	Gray
0	0000	0000
1	0001	0001
2	0010	0011
3	0011	0010
4	0100	0110
5	0101	0111.

(starting 0 then add)

Q Binary → gray :-

1) $(10101100)_2 \rightarrow (11111010)$ gray code.

here

1 + 1 / 0

$1+1=1$

* ~~[illegible]~~ Gray → Binary :-

1) (1101) = $(1001)_2$

1001

2) (1001) = $(1110)_2$

1110

⇒ Excess 3 Code :-

add 3

(87) → $8+3$ $7+3$

(87→E·3 code) $=11$ 10

binary No of 11   " of 10

→ 1011   1010

$= (10111010)$

⇒ Hexadecimal Subtraction :-

1) $^{3}\overset{\frown}{4}A6 -$ $A = 10$

$1\,B\,3$ $B = 11$

$2F3$

(4-ൽ നിന്ന് വാങ്ങുന്നത് 16 ആണ്.)

$16+10 = 26$

$26-11 = 15$ (F)

$16+11 \to 27-12 = 15$ (F)

OR → +
AND → x.

2) $^{6}\overset{\frown}{7}Bb -$ $B = 11$

$6C5$ $C = 12$

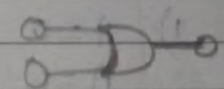
$2F1$

⇒ Boolean Algebra :- True - 1 false - 0

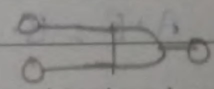
* It is the branch of algebra in which values of variables are the truth values T & F, usually denoted 1 & 0 respectively.

a) Logical Addition (OR operator) :-

Input		Output
A	B	OR / A+B
0	0	0
0	1	1
1	0	1
1	1	1



b) Logical Multiplication (AND operator) :-

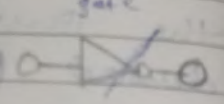


A	B	A·B
0	0	0
0	1	0
1	0	0
1	1	1

c) **Complementation** (NOT operator) :-

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

gate



It is a unary operator.

=> **postulates of Boolean Algebra** :-

1) A = 0 (when A ≠ 1)
   A = 1 (when A ≠ 0).

2) A + 0 = A (Identity law)
   A · 1 = A

3) A + B = B + A (Commutative law)
   A · B = B · A.

4) **Associative law** :-
   A + (B + C) = (A + B) + C
   A · (B · C) = (A · B) · C.

5) **Distributive law** :-
   A · (B + C) = A · B + A · C
   A + (B · C) = (A + B) (A + C).

6) **Compliment law** :-
   $A + \bar{A} = 1$
   $A \cdot \bar{A} = 0$

=> **Principle of Duality** :-

States that "Dual of expression can be achieved by replacing the AND operator with OR operator. Also 0 with 1, & 1 with 0.

eg :- 1+1 = 1 is 0·0 = 0
0·1 = 0 is 1+0 = 1 } by Pri... of (D)

→ Theorems of Boolean Algebra :-

a) Idempotent law :-

(a) $A+A=A$

$A \cdot A = A$.

By Truth table

A	$A+A=A$
0	$0+0=0$
1	$1+1=1$.

possible values

(A - as values change A+A → [illegible])

b) Dominance law :-

$A+1=1$

$A \cdot 0 = 0$.

Truth table.

A	$A+1$.	$A \cdot 0$.
0	$0+1=1$	$0 \cdot 0 = 0$
1	$1+1=1$	$1 \times 0 = 0$

→ 1 same. ok

c) Absorption law :-

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

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

A	B	$A \cdot B$	$A+(A \cdot B)$
0	0	0	0
0	1	0	0
1	0	0	1
1	1	1	1

here. $A+(A \cdot B)=A$.

$A \cdot (A+B) = A$.

A	B	$A+B$	$A \cdot (A+B)$
0	0	0	0
0	1	1	0
1	0	1	1
1	1	1	1

here $A \cdot A+B = A$.

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

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

A	B	$\bar{A}$	$\bar{A}+B$	$A \cdot B$	$A \cdot (\bar{A}+B)$
0	0	1	1	0	0
0	1	1	1	0	0
1	0	0	0	0	0
1	1	0	1	1	1

here $A \cdot (\bar{A}+B) = A \cdot B$.

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

A	B	$\bar{A}$	$\bar{A} \cdot B$	$A+B$	$A+(\bar{A} \cdot B)$
0	0	1	0	0	0
0	1	1	1	1	1
1	0	0	0	1	1
1	1	0	0	1	1

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

8) De-morgans law:-

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

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

A	B	$\bar{A}$	$\bar{B}$	$\bar{A}\cdot\bar{B}$	$A+B$	$\overline{A+B}$
0	0	1	1	1	0	1
0	1	1	0	0	1	0
1	0	0	1	0	1	0
1	1	0	0	0	1	0

here $\overline{A+B} = \bar{A}\cdot\bar{B}$

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

A	B	$\bar{A}$	$\bar{B}$	$\bar{A}+\bar{B}$	$A\cdot B$	$\overline{A\cdot B}$
0	0	1	1	1	0	1
0	1	1	0	1	0	1
1	0	0	1	1	0	1
1	1	0	0	0	1	0

here $\overline{A\cdot B} = \bar{A}+\bar{B}$

0 & 1 → Boolean variable

(a+b) → B. expression

Q.

i) Simplify $C + \overline{BC}$ $(\overline{BC} \rightarrow \bar{B}+\bar{C})$

$C + (\bar{B}+\bar{C})$ → De-morgan's law

($\bar{C}$ common) $(C+\bar{C})+\bar{B}$ → Commutative & Asso. law

$T + \bar{B}$ → Compliment

T → Identity

⇒ Minterm (m) & Maxterm (M) :-

0 → Compliment [illegible]

1 → [illegible]

x	y	z	Minterm	Notations
0	0	0	$x'y'z'$	m_0
0	0	1	$x'y'z$	m_1
0	1	0	$x'yz'$	m_2
0	1	1	$x'yz$	m_3
1	0	0	$xy'z'$	m_4
1	0	1	$xy'z$	m_5
1	1	0	xyz'	m_6
1	1	1	xyz	m_7

minterm

minterm → m (notation)

operations are done by OR operator.

Minterm $= xyz \rightarrow$ Σ
Maxterm $= x+y+z \rightarrow$ Π

→ by table notations.

Q i) $F = x'yz + xy'z + xyz' + xyz.$
$= m_3 + m_5 + m_6 + m_7$

$F(x,y,z) = \Sigma(3,5,6,7)$

* Maxterm → ones 1 → complement ആക്കുക
0 → Evens

x	y	z	maxterm	Notations
0	0	0	xyz	M_0
0	0	1	xyz'	M_1
0	1	0	$xy'z$	M_2
0	1	1	$xy'z'$	M_3
1	0	0	$x'yz$	M_4
1	0	1	$x'yz'$	M_5
1	1	0	$x'y'z$	M_6
1	1	1	$x'y'z'$	M_7.

Q
1) $F = (x+y+z)\cdot(x+y+z')\cdot(x+y'+z)$
$= M_0 \cdot M_1 \cdot M_2$

$F(x,y,z) = \Pi(0,1,2)$

Maxterm → sum of products.
SOP exp → $1 \rightarrow 0$
POS exp → $0 \rightarrow 1$

⇒ Canonical form:-
To convert 1 C. form to its dual → use De-morgan's law & duality principle.

Q 1) → Generate SOP exp. for following truth table.

sum of products

A	B	C	X
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

A) (Take 1 + no. 0. of maxterm)

$A = 0 \quad B = 0 \quad C = 1 \quad = A'B'C$
$A = 0 \quad B = 1 \quad C = 1 \quad = A'BC$
$A = 1 \quad B = 0 \quad C = 0 \quad = AB'C'$
$A = 1 \quad B = 1 \quad C = 0 \quad = ABC'$

Take $0 \rightarrow$ no 1

$\overline{A}\overline{B}\cdot C + \overline{A}BC + A\overline{B}\overline{C} + AB\overline{C}$

(0 ഉള്ളതിന് $\bar{A}$ കൊടുക്കുക)

SOP → Max → 1 → 0!
POS → Mis → 0 → 1'

2) Product of Term → +, ·

A	B	C	X
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

~~ABC~~ A = 0 B = 0 C = 0
A = 0 B = 1 C = 0
A = 1 B = 0 C = 1
A = 1 B = 1 C = 1

$0 \to 1'$

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

⇒ K Map :- (Karnaugh Map)

Method of simplifying B. Algebra.
2^n → form.
Address code → Grey code.

* A, B → 2 variables.

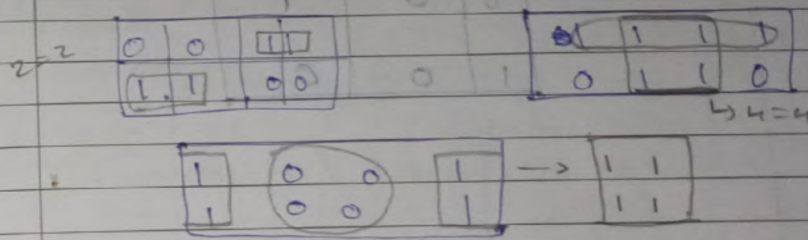
A \ B	0	1
0	m_0	m_1
1	m_2	m_3

Grey code

$m_0 = (00)$
$m_1 = (01)$
$m_2 = (10)$
$m_3 = (11)$

⇒ Minterm Soln of K-Map :-

2^2



4 = 4.
$4=4$

(grp should be equal)

Q) $Y = \bar{A}\bar{B}\bar{C} + \bar{A}B\bar{C} + A\bar{B}\bar{C} + A\bar{B}C + AB\bar{C} + ABC$.

A)

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

Simplified ex is $Y = \bar{A} + \bar{C}$