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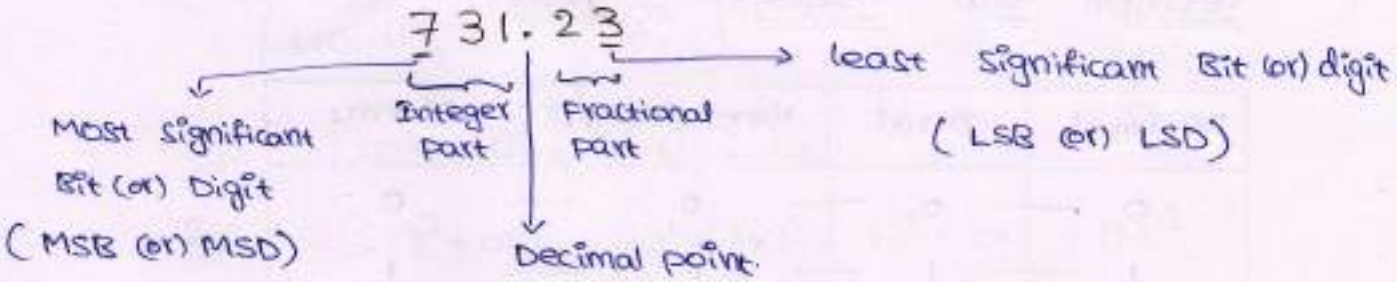
UNIT-I

1. NUMBER SYSTEMS AND BOOLEAN ALGEBRA

1. Decimal number System:-

0, 1, 2, 3, 4, 5, 6, 7, 8, 9 (10 digits)

Ex:- 73_{10}, 48.92_{10} → Base (or) Radix (or) Index.



10^2 10^1 10^0 10^{-1} 10^{-2} → positional values (or) weights.
7 3 1 . 2 3

2. Binary number System:-

0, 1 (2 digits)

Ex:- 1101_2, 11001.01_2

2^2 2^1 2^0 2^{-1} 2^{-2} → positional values (or) weights
1 0 1 . 0 1
↓
Binary point

3. Octal number System:-

0, 1, 2, 3, 4, 5, 6, 7 (8 digits)

Ex:- 73_8, 4072_8, 123.65_8

8^2 8^1 8^0 8^{-1} 8^{-2} → weights (or) positional values.
1 2 3 . 6 5
↓
Octal point.

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4. Hexa decimal number system:-

0, 1, 2, 3, 4, 5, 6, 7, 8, 9, A, B, C, D, E, F (16 digits)

Ex:- $B73_{16}$, $57A.C3_{16}$

16^2 16^1 16^0 16^{-1} 16^{-2} → weights (or) positional values.

1 2 A . 1 3

↓

Hexa decimal point.

* Relation b/w number systems:-

Decimal	Octal	Hexa decimal	Binary
0	0	0	0
1	1	1	1
2	2	2	10
3	3	3	11
4	4	4	100
5	5	5	101
6	6	6	110
7	7	7	111
8	10	8	1000
9	11	9	1001
10	12	A	1010
11	13	B	1011
12	14	C	1100
13	15	D	1101
14	16	E	1110
15	17	F	1111
16	20	10	10000
17	21	11	10001

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Number Base conversion :-

1. Binary to Decimal conversion :-

Ex:- ① $(101.11)_2 = (\ ?\ )_{10}$

$2^2\ 2^1\ 2^0\ 2^{-1}\ 2^{-2}$

Sol:- 1 0 1 . 1 1

$= 1\times2^2 + 0\times2^1 + 1\times2^0 + 1\times2^{-1} + 1\times2^{-2}$

$= 4 + 0 + 1 + 0.5 + 0.25 = 5.75$

$\boxed{(101.11)_2 = (5.75)_{10}}$

② $(1011.101)_2 = (\ ?\ )_{10}$

Sol:- $1\times2^3 + 0\times2^2 + 1\times2^1 + 1\times2^0 + 1\times2^{-1} + 0\times2^{-2} + 1\times2^{-3}$

$= 8 + 2 + 1 + \frac{1}{2} + \frac{1}{8}$

$= (11.625)_{10}$

$\boxed{(1011.101)_2 = (11.625)_{10}}$

2. Octal to Decimal conversion :-

Ex:- ① $(75.3)_8 = (\ ?\ )_{10}$

Sol:- $= 7\times8^1 + 5\times8^0 + 3\times8^{-1}$

$= 56 + 5 + \frac{3}{8} = (61.375)_{10}$

$\boxed{(75.3)_8 = (61.375)_{10}}$

② $(624.712)_8 = (\ ?\ )_{10}$

Sol:- $6\times8^2 + 2\times8^1 + 4\times8^0 + 7\times8^{-1} + 1\times8^{-2} + 2\times8^{-3}$

$= 6\times64 + 16 + 4 + \frac{7}{8} + \frac{1}{64} + \frac{2}{64\times8}$

$= 384 + 20 + 0.875 + 0.015625 + 0.00390625$

$= (404.894)_{10}$

$\boxed{(624.712)_8 = (404.894)_{10}}$

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Ex:- ③ $(482.31)_8 = (\ ?\ )_{10}$

It is not an octal number.

So, conversion is not possible.

③ Hexadecimal to Decimal conversion :-

Ex:- ① $(7A2.C9)_{16} = (\ ?\ )_{10}$

Sol:- $7\times16^2 + A\times16^1 + 2\times16^0 + C\times16^{-1} + 9\times16^{-2}$

$= 7\times256 + 10\times16 + 2\times1 + \frac{12}{16} + \frac{9}{256}$

$= 1792 + 160 + 2 + \frac{3}{4} + 0.3515625$

$= (1954.78)_{10}$

$\boxed{(7A2.C9)_{16} = (1954.78)_{10}}$

② $(CD3.B7)_{16} = (\ ?\ )_{10}$

Sol:- $C\times16^2 + D\times16^1 + 3\times16^0 + B\times16^{-1} + 7\times16^{-2}$

$= 12\times256 + 13\times16 + 3\times\frac{11}{16} + \frac{7}{256}$

$= (3283.715)_{10}$

$\boxed{(CD3.B7)_{16} = (3283.715)_{10}}$

④ Base 5 no. to Decimal conversion :-

Ex:- ① $(431.23)_5 = (116.52)_{10}$

Sol:- $4\times5^2 + 3\times5^1 + 1\times5^0 + 2\times5^{-1} + 3\times5^{-2}$

$= 100 + 15 + 1 + \frac{2}{5} + \frac{3}{25}$

$= (116.52)_{10}$

$\boxed{(431.23)_5 = (116.52)_{10}}$

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⑤ $(231.12)_3 = (\ ?\ )_{10}$

Sol:- It is not a Base 3 no.

Base 3 no. digits are 0, 1, 2.

⑥ Decimal to Binary conversion :-

Ex:- ① $(13.25)_{10} = (\ ?\ )_2$

Sol:- Integer part conversion

2 | 13	
2 | 6 – 1	↑ all remainders from bottom to top
2 | 3 – 0	
2 | 1 – 1	
0 – 1	

$(13)_{10} = 1101_2$

Fractional part conversion

$0.25 \times 2 = 0.5$

$0.5 \times 2 = 1.0$ ↓

Integer parts of all product terms from top to bottom.

$0.25_{10} = 0.01_2$

$\boxed{(13.25)_{10} = (1101.01)_2}$

② $(5.6)_{10} = (?)_2$

Sol:- I.P.C.

2 | 5	
2 | 2 – 1	↑
2 | 1 – 0	
0 – 1	

$(5)_{10} = (101)_2$

F.P.C

$0.6 \times 2 = 1.2$

$0.2 \times 2 = 0.4$

$0.4 \times 2 = 0.8$

$0.8 \times 2 = 1.6$

$0.6 \times 2 = 1.2$

$0.2 \times 2 = 0.4$

$0.4 \times 2 = 0.8$

$0.8 \times 2 = 1.6$.

↓ $0.\overline{1001}$

$(5.6)_{10} = (101.\overline{1001})_2$

Note :- If there is no repetation in that case the process of multiplication is to be stopped after 4 or 5 places.

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7. Decimal to octal conversion :-

Ex:- (i) $(73.625)_{10} = (\ ?\ )_8$

Sol:- Integer conversion

8	73	
8	9	-1
8	1	-1
	0	-1

$(73)_{10} = (111)_8$

Fractional part convertion

$0.625 \times 8 = 5.000$ ↓

$(0.625)_{10} = (0.5)_8$

$\therefore \boxed{(73.625)_{10} = (111.5)_8}$

(ii) $(296.198)_{10} = (\ ?\ )_8$

Sol:- Integer part conversion

8	296	
8	37	-0
8	4	-5
	0	-4

$(296)_{10} = (450)_8$

Fractional part convertion

$0.198 \times 8 = 1.584$
$0.584 \times 8 = 4.672$
$0.672 \times 8 = 5.376$
$0.376 \times 8 = 3.008$
$0.008 \times 8 = 0.064$
$0.064 \times 8 = 0.512$

$(0.198)_{10} = (0.145300)_8$

$\boxed{(296.198)_{10} = (450.145300)_8}$

8. Decimal to Hexa decimal :-

Ex:- (i) $(1954.785)_{10} = (\ ?\ )_{16}$

Sol:- Integer part conversion

16	1954	
16	122	-2
16	7	-(10)A
	0	-7

$(1954)_{10} = (7A2)_{16}$

Fractional Part conversion

$0.785 \times 16 = 12.56$ C
$0.56 \times 16 = 8.96$ 8
$0.96 \times 16 = 15.36$ F
$0.36 \times 16 = 5.76$ 5
$0.76 \times 16 = 12.16$ C

$(0.785)_{10} = (0.C8F5C)_{16}$

$\therefore \boxed{(1954.785)_{10} = (7A2.C8F5C)_{16}}$

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