:- Number System :-

There are many number system to represent a number. but we will discuss four of them:-

i) Binary ii) Octal iii) Decimal iv) Hexadecimal.

→ Binary number System:-

In binary number system, every number is represented using 2 numbers '0' and '1'.

base/radix = 2

NOTE:- base or radix is the no. of unique digits in number system to represent others. In case of binary it is '1' and '0' which is equal to 2.

→ Octal number System :-

In octal number system, we use 8 unique digits to represent any number.

These numbers are,

0, 1, 2, 3, 4, 5, 6, 7

base = 8

ex. - $(165)_8$, $(172)_8$

we will use this bracket ( ) type method to represent that number is in which number system. And for this with numbers we write their base in subscript / $(\ )_{base}$.

→ Decimal number System :-

This is the number system we use in day to day life.

We use 10 different and unique digits to represent any number.

These digits are.

0, 1, 2, 3, 4, 5, 6, 7, 8, 9

base = 10

ex-

$(100)_{10}$, $(7296)_{10}$

→ Hexadecimal number system:-

In hexadecimal number system we use 16 unique digits/char. to represent different numbers.

These digits/chars. are-

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

here,

A corresponds to 10
B " " 11
C " " 12
D " " 13.
E " " 14
F " " 15

Table of numbers and their binary form in 2 bit, 3 bit and 4 bit.

numbers	2 bit	3 bit	4 bit
0	00	000	0000
1	01	001	0001
2	10	010	0010
3	11	011	0011
4		100	0100
5		101	0101
6		110	0110
7		111	0111
8			1000
9			1001
A (10)			1010
B (11)			1011
C (12)			1100
D (13)			1101
E (14)			1110
F (15)			1111

⇒ Decimal to binary conversion:-

While converting decimal to binary or any other conversion we convert integral part and decimal part respectively.

For integral part devide the integer by 2 and take reminder from ~~top to bottom~~ bottom to top.

For decimal part multiply the decimal part by 2 and collect integral part, do this 3-4 times.

ex.-

$(30.45)_{10} = (?)_2$

For integral part -

2	30	0
2	15	1
2	7	1
2	3	1
	1	

$(30)_{10} = (11110)_2$

For decimal part -

$0.45 \times 2 = 0.90 \rightarrow 0$
$0.90 \times 2 = 1.60 \rightarrow 1$
$0.60 \times 2 = 1.20 \rightarrow 1$
$0.20 \times 2 = 0.40 \rightarrow 0$

top to bottom

$(0.45)_{10} = (0110)_2$

So,

$(30.45)_{10} = (11110.0110)_2$

⇒ Decimal to Octal number system :-

Devide decimal by 8 get reminder until it is not possible.

eg -

- $(378.93)_{10} = (?)_8$

for integral part :-

8	378	
8	47	2
	5	7
	0	5

$(378)_{10} = (572)_8$

for decimal part :-

$0.93 \times 8 = (7).44$ → 7
$0.44 \times 8 = (3).52$ → 3
$0.52 \times 8 = (4).16$ → 4
$0.16 \times 8 = (1).28$ → 1

$(0.93)_{10} = (0.7341)_8$

hence.

$(378.93)_{10} = (572.7341)_8$

⇒ Decimal to hexadecimal conversion:-

Devide given decimal number by 16 until quotent belomes zero.

ex.-

$$(2598.675)_{10} = (?)_{16}$$

For integral part -

16	2598	6
16	162	2
16	10	10
	0	

$$(2598)_{10} = (A26)_{16}$$

For decimal part

$0.675 \times 16 =$ 16.8 — 10

$0.800 \times 16 = 12.8$ — 12

$0.80 \times 16 = 12.8$ — 12

$$(0675)_{10} = (ACC)_{16}$$

So.

$$(2598.675)_{10} = (A26.ACC)_{16}$$

⇒ Binary to decimal conversion :-

To convert we use weightage method. we will get sum of binary number multiplied with $2^{\text{Position weight}}$

ex.-

$$(10101)_2 = (?)_{10}$$

10101

P.W- 4 3 2 1 0

So,

$$1\times2^4 + 0\times2^3 + 1\times2^2 + 0\times2^1 \times 1\times2^1$$

$$= 16 + 0 + 4 + 0 + 1 = 21$$

So,

$$(10101)_2 = (21)_{10}$$

⇒ ~~Binary to Octal conversion:-~~

⇒ Octal to binary:-

- just write binary value for each octal value in 3 bit form.

$(367.52)_8 = (011110111.101010)_2$

octal	binary
3 -	011
6 -	110
7 -	111
5 -	101
2 -	010

⇒ Binary to Octal conversion:-

Convert 3 bit of binary to its octal form using table.

0	000
1	001
2	010
3	011

4 — 100
5 — 101
6 — 110
7 — 111

$(110\,101\,10.101\,101)_2 = (326.53)_8$

⇒ Binary to hexadecimal :-
Convert 4 bit of binary to its hexa decimal form using table.

$(1000\,1011\,1101.0010\,1111)_2 = (?)_{16}$

$(8\ B\ D.2\ F)_{16} =$

1000 - 8
1011 - 11 - B
1101 - 13 - D
0010 - 2
1111 - 15 - F

⇒ Hexa decimal to binary

just write binary value of each digit in 4 bit representation according to table.

0	—	0000	1	—	0001
2	—	0010			
3	—	0011			
4	—	0100			
5	—	0101			
6	—	0110			
7	—	0111			
8	—	1000			
9	—	1001			
A 10	—	1010			
B 11	—	1011			
C 12	—	1100			
D 13	—	1101			
E 14	—	1110			
F 15	—	1111			

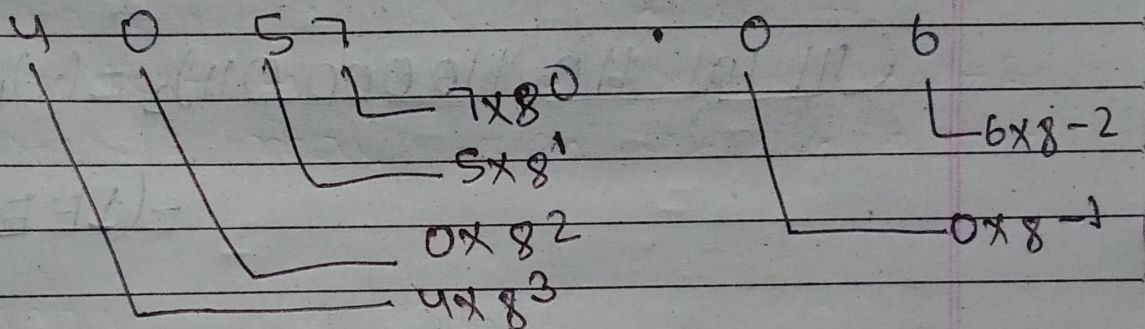
$(4BAC)_{16} = (0100\ 1011\ 1010\ 1100)_2$

$(3A9E.B0D)_{16} = (0011\ 1010\ 1001\ 1110.\ 1011\ 0000\ 1101)$

→ Octal to decimal

multiply each number with weight of each position (8 Position no) and then calculate sum.

$$(4057.06)_8 = (?)_{10}$$



so,

$$4\times512 + 0 + 40 + 7 + 0 + 6\times\frac{1}{64}$$

$$= 2048 + 40 + 7 + 6\times\frac{1}{64}$$

$$= 2048 + 40 + 7 + 0.0937$$

$$= 2095.0937$$

→ Octal to hexadecimal :-

Convert octal to binary then binary to hexadecimal.

$(756.603)_8 = (x)_{16}$

→ $(756.603)_8 = (111\ 101\ 110.110\ 000\ 011)_2$

$(111\ 101\ 110.110\ 000\ 011)_2 = (x)_{16}$

$= (1EE.C18)_{16}$

→ Hexadecimal to decimal

Convert Hexa to binary then binary to decimal.

$(5C7)_{16} = (x)_{10}$

$(0101\ 1100\ 0111)_2 = (x)_{10}$

$1\times2^{10} + 1\times2^8 + 1\times2^7 + 1\times2^6 + 1\times2^2 + 1\times2^1 + 1\times2^0$

$= 1024 + 256 + 128 + 64 + 4 + 2 + 1$

$= 1479$

$3 \times 512 + 12 \times 64 + 8 + \frac{7}{64}$ $= 1672.015625$

$= 1536 + 128 + 8 + 0.015625$

OR you can use another method.

$(5\ C\ 7)_{16} = (X)_{10}$

$5 \times 16^2 + 12 \times 16^1 + 7 \times 16^0 = 1479$

→ Hexadeimal to octal conversion.

Hexa → binary → octal.

$(B9F \cdot AE)_{16} = (X)_8$

$(B9F \cdot AE)_{16} \rightarrow (1011\ 1001\ 1111 \cdot 1010\ 1100)_2$

↓ octal

$(5637 \cdot 534)_8$

convert any number system to decimal use weighted sum procedure.

Q. $(4433)_5 = (x)_2$

⇒

First convert it in decimal the binary.

$(4433)_5 = 4\times5^3 + 4\times5^2 + 3\times5^1 + 3\times5^0$

$= (618)_{10}$

$(618)_{10} = (\quad)_2$

Q. $(1221)_3 = (x)_{10}$

$\Rightarrow 1\times3^3 + 2\times3^2 + 2\times3^1 + 1\times3^0$

$= 27 + 18 + 6 + 1 = 52$

Q $16_{10} = 100_b$, $b = ?$

$\Rightarrow (100)_b = 1\times b^2 + 0 + 0 = (16)_{10}$

$\Rightarrow b^2 = 16$

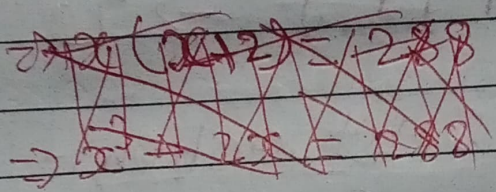
$\Rightarrow b = 4$

Q. $(292)_{10} = (1204)_x$

$\Rightarrow 1 \cdot x^3 + 2x^2 + 4 = 292$

$\Rightarrow x^3 + 2x^2 + 4 = 292$

$\Rightarrow x^3 + 2x^2 = 288$



by hit and trail method

$x = 6$

→ Rules for binary arithmetic:-

i) binary addition:-

$0+0=0$, $0+1=1$, $1+0=1$

$1+1=0$ (with carry 1)

ex.-

$$\begin{array}{r} 1101.101 \\ +\ 111.011 \\ \hline 10101.000 \end{array}$$