NUMBER SYSTEM

What is a number?
A number is an arithmetic value representing a particular quantity and used in counting and calculations.

What is a number system?
It is a system that expresses numbers using a given set of digits or symbols.

Types of Number system:
1. Positional number system
2. Non-positional number system

Positional number system	Non-positional number system
There are 3 parts of a positional number system: 1. Digits 2. Base (radix) 3. Position value (face value) e.g. $153 = 100+50+3 = 1\times10^2 + 5\times10^1 + 3\times10^0$ $531 = 500+30+1 = 5\times10^2 + 3\times10^1 + 1\times10^0$	It is having only symbols. e.g. Roman nos. and Tally marking

There are four positional number systems used in computing –
1. Decimal no.   Base:10   Digits: 10 (0 to 9)
2. Binary no.   Base:2   Digits: 2 (0, 1)
3. Octal no.   Base:8   Digits: 8 (0 to 7)
4. Hexadecimal no. Base:16   Digits: 10 (0 to 9) + 6 (A to F)

Conversion in Number system:
1. Decimal to other systems (binary/octal/hexadecimal)
2. Other (binary/octal/hexadecimal) system to decimal
3. Other system to other system (Binary to octal/hexadecimal and v.v.)

Decimal to Binary conversion

Let us take this no. $(23.55)_{10}$

23 to binary

Base	Number	Reminder
2	23	1
2	11	1
2	5	1
2	2	0
2	1	1
	0	

$(23)_{10} = (10111)_2$

Base	Number	Value	Digit
2	0.55	1.1	1
2	0.1	0.2	0
2	0.2	0.4	0
2	0.4	0.8	0
2	0.8	1.6	1
2	0.6	1.2	1

$(0.55)_2 = (0.100011)_2$

$(23.55)_{10} = (10111.100011)_2$ Approx

Binary to decimal

```
 5  4  3  2  1  0    -1 -2 -3 -4
 1  0  1  0  1  1  .  1  1  0  1
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No.x Base^{pos}

$= 1 \times 2^5 + 1 \times 2^3 + 1 \times 2^1 + 1 \times 2^0 + 1 \times 2^{-1} + 1 \times 2^{-2} + 1 \times 2^{-4}$
$= 32+8+2+1+0.5+0.25+0.0625$
$= 43.8125$

Another example on Decimal to other system conversion
(123.125)$_{10}$ to binary/octal/hexadecimal

1. (123)$_{10}$ to binary/octal/hexadecimal -> whole no. conversion
2. (0.125)$_{10}$ binary/octal/hexadecimal -> fractional no. conversion

For Binary conversion

2	123	**1**
2	61	**1**
2	30	**0**
2	15	**1**
2	7	**1**
2	3	**1**
2	1	**1**
	0	

(123)$_{10}$ = (1111011)$_2$

0.125x2	0.25	0
0.25x2	0.5	0
0.5x2	1.0	1

(0.125)$_{10}$ = (0.001)$_2$

(123.125)$_{10}$ = (1111011.001)$_2$ Ans

For Octal conversion

8	123	**3**
8	15	**7**
8	1	**1**
	0	

(123)$_{10}$ = (371)$_8$

0.125x8	1.0	1

(0.125)$_{10}$ = (0.1)$_8$

(123.125)$_{10}$ = (371.1)$_8$ Ans

For Hexadecimal conversion

16	123	**11**
16	7	**7**
	0	

(123)$_{10}$ = (B7)$_{16}$

0.125x16	2.0	2

(0.125)$_{10}$ = (0.2)$_{16}$

(123.125)$_{10}$ = (B7.2)$_{16}$ Ans