Definition of Number System (Decimal and Binary)

Introduction :-

The numerals we use today are 0, 1, 2, 3, 4, 5, 6 7, 8 and 9. These numbers are a part of decimal System, because there are only 10 basic Symbols.

Expressing the decimal no. 63472 in the expanded form, we get :

In the decimal no. 63472

2 is at the unit's digit and has a place value of 1 ···· 2 ones.
7 is at the ten's digit and has a place value of 10 ···· 7 tens.
4 is at the hundred's digit and has a place value of 100 ···· 4 hundreds
3 is at the thousand's digit and has a place value of 1000 ···· 3 Thousands
6 is at the ten thousand's digit and has a place value of 10000 ··· 6 ten Thousands

Thus the no. can be represented as

$$63472 = 6\times10^4 + 3\times10^3 + 4\times10^2 + 7\times10^1 + 2\times10^0$$
$$= 60,000 + 3000 + 400 + 70 + 2.$$

Thus, Since there are 10 sysbols, this system of representation of numbers is known as the Decimal System (base 10). In a similar way, a system in which only 0 and 1 exist, is known as Binary System (base 2).

Inventor of binary System - Gottfried Wilhelm Leibniz (1646-1716).

Conversion of Base

I. Decimal to Binary conversion:-

To convert the decimal number to binary we begin by dividing the decimal number by 2 and then dividing each resulting quotient by 2 until there is a 1 quotient.

Ex-1 Convert the decimal number 50 to a binary number.

Soln: Remainder

2	50	0
2	25	1
2	12	0
2	6	0
2	3	1
	1	

2	50	
2	25	0
2	12	1
2	6	0
2	3	0
	1	1

Hence the binary equivalent of 50 is $(110010)_2$

Ex-2 Convert the binary number 110010 to a decimal no.

Soln: $1\times 2^5 + 1\times 2^4 + 0\times 2^3 + 0\times 2^2 + 1\times 2^1 + 0\times 2^0$

$= 32 + 16 + 0 + 0 + 2 + 0 = 50.$

Ex-3 Convert the binary number 1001100101 to decimal number.

Soln: 1001100101

$= 1\times 2^9 + 0\times 2^8 + 0\times 2^7 + 1\times 2^6 + 1\times 2^5 + 0\times 2^4 + 0\times 2^3 + 1\times 2^2 + 0\times 2^1 + 1\times 2^0.$

$= 512 + 64 + 32 + 4 + 1 = 613.$

Ex-4 Convert the decimal no. 90 to a binary no.

Soln:-

2	90	0
2	45	1
2	22	0
2	11	1
2	5	1
2	2	0
	1	

Hence the binary equivalent of 90 is $(1011010)_2$.

Verification :-

$$(1011010)_2 = 1\times 2^6 + 0\times 2^5 + 1\times 2^4 + 1\times 2^3 + 0\times 2^2 + 1\times 2^1 + 0\times 2^0$$
$$= 64 + 0 + 16 + 8 + 0 + 2 + 0$$
$$= 90.$$

Ex-5 Convert the decimal no. 88 to a binary no.

Soln:-

2	88	0
2	44	0
2	22	0
2	11	1
2	5	1
2	2	0
	1	

Hence the binary equivalent of 88 is $(1011000)_2$

Verification

$$(1011000)_2 = 1\times 2^6 + 0\times 2^5 + 1\times 2^4 + 1\times 2^3 + 0\times 2^2 + 0\times 2^1 + 0\times 2^0$$
$$= 64 + 16 + 8$$
$$= 88 \quad \#$$