

# NUMBERING SYSTEMS

## Introduction

For communicating with the computer you need to write a program. In earlier days the programmers used to write program in a machine code (a language in the form of 0 & 1) but it was a very difficult task so assembly language was invented. The hexadecimal system was used to communicate with computer that was better & faster from binary system.

For converting a program written in assembly language to hex file an assembler program is used. But the assembly language too is cumbersome as it deals directly with the internal architecture of a CPU therefore it is referred as a low level language. Today we have so many other high level languages such as C, C++, Java, etc (they have a compiler to convert a program to hex file). We shall learn now how the decimal, binary & hexadecimal numbers are inter-related.

## Numbering System

In this session I will familiarize you with the number systems those who are already familiar can skip this session.

Decimal is number system to the base 10 i.e. from 0-9, 10-19 & so on. We use this in our day to day life.

Binary is number system to base 2, the language of computing.

For e.g.  $30_{10} = 11110_2$  (the number in subscript denotes the base)

**Converting from decimal to binary:**

	Quotient	Remainder	
30/2	15	0	← Least Significant Digit (L.S.D)
15/2	7	1	
7/2	3	1	
3/2	1	1	
1/2	0	1	← Highest Significant Digit (H.SD)
		30 = 11110 <sub>2</sub>	

**Converting from binary to decimal:**

e.g.  $1010101 = 2^0 * 1 + 2^1 * 0 + 2^2 * 1 + 2^3 * 0 + 2^4 * 1 + 2^5 * 0 + 2^6 * 1 = 1 + 4 + 16 + 64 = 85$

Hexadecimal: (Hex) to base 16, all the program need to be converted to hexadecimal as they represent the machine language.

### Converting Decimal to Hex:

Decimal no. :1111 0101 0101

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

For converting a hex to decimal number system convert first to binary & then to decimal system.

You can also use a scientific calculator (provided by Windows) to convert the number among different base. (Provided in accessories of Windows)

A binary number is made of bits. A group of four bit is called a nibble and a group of eight bit is called a byte.

Source : <http://www.botskool.com/tutorials/mechanical/basic-mechanisms-robotics>