**Number systems :**

In general any number N can be represented in the base ( radix ) R as show below :

NR = dnRn  + dn-1 Rn-1 + ……… d1R1 + d0R0

**1-Decimal system ( R= 10 ) :**

This system uses ( 10 ) symbols ( 0 – 9 )

***Ex***: N10 = 23326180 = 2x103 + 3 x 102  +6x101 + 8x100 = 2000 + 300 + 60 + 8= 2368

**2-Binary system (R = 2 ) :**

It uses only two basic symbol ( 0,1 ) . It is the most suitable number system for digital circuits.

***Ex***: N2 = 1413020110 =1(2)4 + 1(2)3 + 0(2)2 + 0(2)1 + 1(2)0  = 16 + 8+0+0+1= ( 25 ) D

***Ex***: 13020110 = 1(2)3 + 0(2)2 + 0(2)1+ 1(2)0= 8+0+0+1 = (9)D

**3-Octal system ( R= 8 ) :**

It uses 8 symbols ( 0- 7 )

***Ex*** : 1170 = 1(8)1 + 7(8)0 = 8+7 =( 15)D

***Ex***: 73024150= 7(8)3 + o(8)2  + 4(8)1 +5(8)0 = 3584 +0 + 32 + 5=( 3621)D

**4- Hexadecimal system ( R =16 )**

It uses 16 symbol :

( 0,1,2,…………..,9,A,B,C,D,E,F )

***Ex***: 11A0 = 1(16)1+ A(16)0 = 16+10 =(26)D

***Ex***:329150 = 3(16)2+ 9(16)1 + 5 (16)0 =768 + 144 + 5 = ( 773)D

**The following table gives the correspondence between the four number system :**

|  |  |  |  |
| --- | --- | --- | --- |
| **Hexadecimal** | **Octal** | **Binary** | **Decimal** |
| 0 | 0 | 0 | 0 |
| 1 | 1 | 01 | 1 |
| 2 | 2 | 10 | 2 |
| 3 | 3 | 11 | 3 |
| 4 | 4 | 100 | 4 |
| 5 | 5 | 101 | 5 |
| 6 | 6 | 110 | 6 |
| 7 | 7 | 111 | 7 |
| 8 | 10 | 1000 | 8 |
| 9 | 11 | 1001 | 9 |
| A | 12 | 1010 | 10 |
| B | 13 | 1011 | 11 |
| C |  | 1100 | 12 |
| D |  |  |  |
| E |  |  |  |
| F |  |  |  |
| 10 |  |  |  |
| 11 |  |  |  |
| 12 |  |  |  |

Continue the above table.

**(Binary , octal and Hexadecimal) to Decimal :**

**For binary number** :

***Ex*** : ( 11010 . 101) 2 = 1(2)4+1(2)3+ 0(2)2+ 1(2)1+ 0(2)0+ 1(2)-1+ 0(2)-2+1(2)-3 =

16+8+2+0.5+0.125 = ( 26.625)10

**For octal number :**

***Ex***: ( 613.24)8 = 6(8)2 +1(8)1+3(8)0+2(8)-1 + 4(8)-2 =

384 + 8 + 3 + 0.25 + 0.0625 = ( 395.3125)10

**For hexadecimal :**

***Ex***: ( 5A.E)16 =5( 16)1+ A(16)0+ E(16)-1 =

5(16)+10(16)+ 14(16)-1 = 80+10+0.875 = (90.875)10