**Lecture 1/ Definitions**

A **number system** defines how a number can be represented using distinct symbols.

A number can be represented differently in different systems.

 For example, the two numbers (2A)16 and (52)8 both refer to the same quantity, (42)10.

In a **positional number system**, the position a symbol occupies in the number determines the value it represents.

In **Non-positional Number System** each symbol has a special and certain value in that position Example: Roman numerals.

**1-1 Number System Representation:**

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