



FACULTY OF ENGINEERING & TECHNOLOGY

NUMBER SYSTEM

Introduction

Number systems provide the basis for all operations in information processing systems. In a number system the information is divided into a group of symbols; for example, 26 English letters, binary, decimal digits etc.

A number system with base or radix r contains, r different digit & they have from 0 to $r-1$.

S.N.	Base(r)	Different Digit (0 to $r-1$)	Number System
1	2	0,1	Binary
2	8	0,1,2,3,4,5,6,7	Octal
3	10	0,1,2,3,4,5,6,7,8,9	Decimal
4	16 or H	0,1,2,3,4,5,6,7,8,9,A,B,C,D,E,F	Hexadecimal

1.Binary Number System

- The binary number has a radix of 2. As $r = 2$, only two digits (0 & 1) are needed.
- Two digits(0 & 1) is also known as binary digit or simply bits.
- A binary number consisting n bits is called an n bit number.
- Each digit is multiplied by an appropriate power of 2 depending on its position in the number.
- A group of 4 bits is called as nibble (e.g.1001).
- A group of 8 bits is called as byte(e.g. 10111001).
- Thus we write binary number as 10000111110,111100, 000011,

NUMBER SYSTEM

2. Octal Number System

- The octal number has a radix of 8.
- Each digit is multiplied by an appropriate power of 8 depending on its position in the number.
- Thus we write octal number as $(22)_8$, $(45)_8$, $(17)_8$

$$N = (2322)_8 = (2 \times 8^3 + 3 \times 8^2 + 2 \times 8^1 + 2 \times 8^0)$$

3. Decimal Number System

- The decimal number has a radix of 10.
- Each digit is multiplied by an appropriate power of 10 depending on its position in the number.
- Thus we write decimal number as $(12)_{10}$, $(345)_{10}$, $(119)_{10}$, $(200)_{10}$, $(313.9)_{10}$

$$N = (30.2)_{10} = (30 \times 10^1 + 0 \times 10^0 + 2 \times 10^{-1})$$

4. Hexadecimal Number System

- The hexadecimal number has a radix of 16 or H.
- Each digit is multiplied by an appropriate power of 16 depending on its position in the number.
- Thus we write decimal number as $(A2)_{16}$, $(34B)_H$, $(89)_{16}$, $(E00)_{16}$

$$N = (A2)_{16} = (A \times 16^1 + 2 \times 16^0)$$

NUMBER SYSTEM

Conversion of a Decimal Number to any other number of base r

To convert decimal number into any other, base r divide integer part & multiply fractional part with base r.

Example 1. Convert the number $(333.625)_{10}$ to $(\dots\dots\dots)_2$.

Integer Part

Division	Quotient	Remainder
$333/2$	166	1 $\uparrow$
$166/2$	83	0
$83/2$	41	1
$41/2$	20	1
$20/2$	10	0
$10/2$	5	0
$5/2$	2	1
$2/2$	1	0
$1/2$	0	1

Fractional Part

Multiplication	Multiplication Result	Integer Part
0.625×2	1.25	1
0.25×2	0.5	0
0.5×2	1.0	1

$(333.625)_{10}$ to $(101001101.101)_2$.

NUMBER SYSTEM

Example 2. Convert the number $(333.625)_{10}$ to $(\dots\dots\dots)_8$.

Integer Part

Division	Quotient	Remainder
333/8	41	5 ↑
41/8	5	1
5/8	0	5

Fractional Part

Multiplication	Multiplication Result	Integer Part
0.625x8	5.0	5 ↓

$(333.625)_{10}$ to $(515.5)_8$.

Example 3. Convert the number $(333.625)_{10}$ to $(\dots\dots\dots)_{16}$.

Integer Part

Division	Quotient	Remainder
333/16	2	13=D ↑
2/16	0	2

Fractional Part

Multiplication	Multiplication Result	Integer Part
0.625x16	10.0	10=A ↓

$(333.625)_{10}$ to $(2D.A)_{16}$.

NUMBER SYSTEM

Q.1 Convert the following numbers from base 10 to base 16-

• $(2020)_{10}$

• $(2020.65625)_{10}$

• $(172)_{10}$

• $(172.983)_{10}$

Q.2 $(2020.65625)_{10} \rightarrow (?)_8$

Q.3 $(25)_{10} \rightarrow (?)_2$

Q.4 $(23.5)_{10} \rightarrow (?)_2$

Q.5 $(254)_{10} \rightarrow (?)_{16}$

Q.6 $(32)_{10} \rightarrow (?)_4$

Q.7 $(27.4)_{10} \rightarrow (?)_4$

Q.8 $(25.625)_{10} \rightarrow (?)_8$

