



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, .....

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## 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  $(A2)_{16}$ ,  $(34B)_H$ ,  $(89)_{16}$ ,  $(E00)_{16}$

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

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## Conversion of a Decimal Number to 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 ↑
$166/2$	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
$0.625 \times 2$	1.25	1 ↓
$0.25 \times 2$	0.5	0
$0.5 \times 2$	1.0	1 ↓

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

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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  $(\dots\dots\dots)_{16}$ .

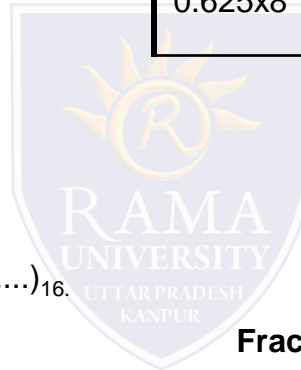
## Integer Part

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  $(2D.A)_{16}$ .



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

