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 o to r-1.

S.N.	Base(r)	Different Digit (o 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, …….

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 $(22)_8$, $(45)_8$, $(17)_8$

$$N=(2322)_8 =(2\times8^3 + 3\times8^2 + 2\times8^1 + 2\times8^0)$$

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 $(12)_{10}$, $(345)_{10}$, $(119)_{10}$, $(200)_{10}$, $(313.9)_{10}$

$$N= (30.2)_{10}= (30\times10^1+0x10^0+2\times10^{-1})$$

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

$$N= (A2)_{16}= (A\times16^2+2x16^0)$$

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 $(.....)_{2.}$

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
0.625x2	1.25	1 ↓
0.25x2	0.5	0
0.5x2	1.0	1

$(333.625)_{10}$ to $(101001101.101)_{2.}$

Example 2. Convert the number $(333.625)_{10}$ to $(.....)_{8.}$

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

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