SNS COLLEGE OF ENGINEERING

Kurumbapalayam (Po), Coimbatore – 641 107

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DEPARTMENT OF ELECTRONICS AND COMMUNICATION ENGINEERING

COURSE NAME : 19EC306 – Digital Circuits

II YEAR / III SEMESTER

Unit I- MINIMIZATION TECHNIQUES AND LOGIC GATES
Topic : Introduction to Digital circuits and Number systems

Number system

If base or radix of a number system is ‘r’, then the numbers present in that number system are ranging from zero to r-1. The total numbers present in that number system is ‘r’.
The following number systems are the most commonly used.
•Decimal Number system
•Binary Number system
•Octal Number system
•Hexadecimal Number system

Example
Consider the **decimal number 1358.246**. Integer part of this number is 1358 and fractional part of this number is 0.246. The digits 8, 5, 3 and 1 have weights of 100, 101, 10^2 and 10^3 respectively. Similarly, the digits 2, 4 and 6 have weights of 10^{-1}, 10^{-2} and 10^{-3} respectively.
Mathematically, we can write it as
$1358.246 = (1 \times 10^3) + (3 \times 10^2) + (5 \times 10^1) + (8 \times 10^0) + (2 \times 10^{-1}) + (4 \times 10^{-2}) + (6 \times 10^{-3})$

Example

Consider the **binary number 1101.011**. Integer part of this number is 1101 and fractional part of this number is 0.011. The digits 1, 0, 1 and 1 of integer part have weights of 2^0, 2^1, 2^2, 2^3 respectively. Similarly, the digits 0, 1 and 1 of fractional part have weights of 2^{-1}, 2^{-2}, 2^{-3} respectively.

Mathematically, we can write it as

$1101.011 = (1 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0) + (0 \times 2^{-1}) + (1 \times 2^{-2}) + (1 \times 2^{-3})$

Example

Consider the **octal number 1457.236**. Integer part of this number is 1457 and fractional part of this number is 0.236. The digits 7, 5, 4 and 1 have weights of 8^0, 8^1, 8^2 and 8^3 respectively. Similarly, the digits 2, 3 and 6 have weights of 8^{-1}, 8^{-2}, 8^{-3} respectively.

Mathematically, we can write it as

$1457.236 = (1 \times 8^3) + (4 \times 8^2) + (5 \times 8^1) + (7 \times 8^0) + (2 \times 8^{-1}) + (3 \times 8^{-2}) + (6 \times 8^{-3})$

Mathematically, we can write it as for hexadecimal

$1A05.2C4 = (1 \times 16^3) + (10 \times 16^2) + (0 \times 16^1) + (5 \times 16^0) + (2 \times 16^{-1}) + (12 \times 16^{-2}) + (4 \times 16^{-3})$

Decimal to Binary Conversion

Example

Consider the **decimal number 58.25**. Here, the integer part is 58 and fractional part is 0.25.

Step 1 – Division of 58 and successive quotients with base 2.

Operation	Quotient	Remainder
58/2	29	0 LSB
29/2	14	1
14/2	7	0
7/2	3	1
3/2	1	1
1/2	0	1 MSB

$$\Rightarrow 58_{10} = 111010_2$$

Step 2 – Multiplication of 0.25 and successive fractions with base 2.

Operation	Result	Carry
0.25 x 2	0.5	0
0.5 x 2	1.0	1
-	0.0	-

$$\Rightarrow .25_{10} = .01_2$$

Therefore, the **binary equivalent** of decimal number 58.25 is 111010.01.

Decimal to Octal Conversion

Example

Consider the **decimal number 58.25**. Here, the integer part is 58 and fractional part is 0.25.

Step 1 − Division of 58 and successive quotients with base 8.

Operation	Quotient	Remainder
58/8	7	**2**
7/8	0	**7**

$$\Rightarrow 58_{10} = 72_8$$

Step 2 − Multiplication of 0.25 and successive fractions with base 8.

Operation	Result	Carry
0.25 x 8	2.00	2
-	0.00	-

$$\Rightarrow .25_{10} = .2_8$$

Therefore, the **octal equivalent** of decimal number 58.25 is 72.2.

Decimal to Hexa-Decimal Conversion

Example

Consider the **decimal number 58.25**. Here, the integer part is 58 and decimal part is 0.25.

Step 1 − Division of 58 and successive quotients with base 16.

Operation	Quotient	Remainder
58/16	3	10=A
3/16	0	3

$$\Rightarrow 58_{10} = 3A_{16}$$

Step 2 − Multiplication of 0.25 and successive fractions with base 16.

Operation	Result	Carry
0.25 x 16	4.00	4
-	0.00	-

$$\Rightarrow .25_{10} = .4_{16}$$

Therefore, the **Hexa-decimal equivalent** of decimal number 58.25 is 3A.4.

Binary Number to other Bases Conversion

Binary to Decimal Conversion

Example

Consider the **binary number 1101.11**.

Mathematically, we can write it as $1101.11_2 = (1 \times 2^3) + (1 \times 2^2) + (0 \times 2^1) + (1 \times 2^0) + (1 \times 2^{-1}) + (1 \times 2^{-2})$

$\Rightarrow 1101.11_2 = 8 + 4 + 0 + 1 + 0.5 + 0.25 = 13.75$

$\Rightarrow 1101.11_2 = 13.75_{10}$

Binary to Octal Conversion

Example

Consider the **binary number 101110.01101**.

Step 1 − Make the groups of 3 bits on both sides of binary point. 101 110.011 01

Here, on right side of binary point, the last group is having only 2 bits. So, include one zero on extreme side in order to make it as group of 3 bits. ⇒ 101 110.011 010

Step 2 − Write the octal digits corresponding to each group of 3 bits.

$\Rightarrow 101110.011010_2 = 56.32_8$

Any Query????

Thank you……