Introduction - Number Base Conversions

This section describes the conversion of numbers from one number system to another. Radix Divide and Multiply Method is generally used for conversion. There is a general procedure for the operation of converting a decimal number to a number in base r. If the number includes a radix point, it is necessary to separate the number into an integer part and a fraction part, since each part must be converted differently. The conversion of a decimal integer to a number in base r is done by dividing the number and all successive quotients by r and accumulating the remainders. The conversion of a decimal fraction is done by repeated multiplication by r and the integers are accumulated instead of remainders.

Integer part - repeated divisions by r yield LSD to MSD

Fractional part - repeated multiplications by r yield MSD to LSD

Example: Conversion of decimal 23 to binary is by divide decimal value by 2 (the base) until the value is 0

Integer	remainder	
23		
11	1	$\rightarrow$ LSB
5	1	
2	1	
1	0	
0	1	$\rightarrow$ MSB

The answer is $23_{10} = 10111_{2}$

Divide the number by 2; keep track of the remainder; repeat with the dividend equal to the quotient until zero; the first remainder is binary LSB and the last is MSB.

The conversion from decimal integers to any base-r system is similar to the above example, except that division is done by r instead of 2.

Example:
Convert (0.7854) 10 to binary.

0.7854 x 2 = 1.5708; $a_{-1} = 1$

0.5708 x 2 = 1.1416; $a_{-2} = 1$

0.1416 x 2 = 0.2832; $a_{-3} = 0$

0.2832 x 2 = 0.5664; $a_{-4} = 0$

The answer is $(0.7854)_{10} = (0.1100)_2$

Multiply the fraction by two; keep track of integer part; repeat with multiplier equal to product fraction; first integer is MSB , last is the LSB; conversion may not be exact; a repeated fraction. The conversion from decimal fraction to any base-r system is similar to this above example, except the multiplication is done by r instead of 2.

The conversion of decimal numbers with both integer and fraction parts is done by converting the integer and the fraction separately and then combining the two answers.

Thus $(23.7854)_{10} = (10111.1100)_2$

For converting a binary number to octal, the following two-step procedure can be used.

1. Group the number of bits into 3's starting with the least significant bit. If the number of bits is not evenly divisible by 3, then add 0's at the most significant end.

2. Write the corresponding 1 octal digit for each group

Examples:

100 010 111 (binary)
4 2 7 (octal)

10 101 110 (binary)
2 5 6 (octal)

Similarly for converting a binary number to hex, the following two step procedure can be used.

1. Group the number of bits into 4's starting at least significant symbol. If the number of bits is not evenly divisible by 4, then add 0's at the most significant end.

2. Write the corresponding 1 hex digit for each group

Examples:

```
1001 1110 0111 0000  (binary)
  9    e    7    0   (hex)

1 1111 1010 0011     (binary)
1   f    a    3      (hex)
```

The hex to binary conversion is very simple; just write down the 4 bit binary code for each hexadecimal digit .

Example:

```
  3    9    c    8       (hex)
0011 1001 1100 1000      (binary)
```

Similarly, for octal to binary conversion, write down the 8-bit binary code for each octal digit.

The hex to octal conversion can be carried out in 2 steps; first the hex to binary followed by the binary to octal. Similarly, decimal to hex conversion is completed in 2 steps; first the decimal to binary and from binary to hex as described above.