

2. Conversion between Systems: -

(8)

1. Finding the Decimal Equivalent: -

The decimal equivalent of a given number in another number system is given by the sum of all the digits multiplied by their respective weights. The integer and fractional parts of the given number should be treated separately. Binary to decimal, octal to decimal and hexadecimal to decimal conversions are illustrated below: -

2.1 Binary to Decimal Conversion: -

Ex 6: Convert the following binary numbers to decimal: -

- a) 11001      b) 110.001      c) 0.111

Solution: -

$$\begin{aligned} \text{a) } (11001)_2 &\rightarrow (25)_{10} \\ &\begin{array}{cccccc} 2^4 & 2^3 & 2^2 & 2^1 & 2^0 & \\ 1 & 1 & 0 & 0 & 1 & \end{array} \\ &(1 \times 2^4) + (1 \times 2^3) + (0 \times 2^2) + (0 \times 2^1) + (1 \times 2^0) \\ &(1 \times 16) + (1 \times 8) + (0 \times 4) + (0 \times 2) + (1 \times 1) = (25)_{10} \end{aligned}$$

$$\begin{aligned} \text{b) } (110.001)_2 &\rightarrow (6.125)_{10} \\ &\begin{array}{cccccc} 2^2 & 2^1 & 2^0 & 2^{-1} & 2^{-2} & 2^{-3} \\ 1 & 1 & 0 & 0 & 0 & 1 \end{array} \\ &110.001 \\ &(1 \times 2^2) + (1 \times 2^1) + (0 \times 2^0) + (0 \times 2^{-1}) + (0 \times 2^{-2}) + (1 \times 2^{-3}) \\ &(1 \times 4) + (1 \times 2) + (0 \times 1) + (0 \times 0.5) + (0 \times 0.25) + (1 \times 0.125) \\ &= (6.125)_{10} \end{aligned}$$

$$\begin{aligned} \text{c) } (0.111)_2 &= (0.875)_{10} \\ &\begin{array}{cccc} 2^0 & 2^{-1} & 2^{-2} & 2^{-3} \\ 0 & 1 & 1 & 1 \end{array} \\ &0.111 \\ &(0 \times 2^0) + (1 \times 2^{-1}) + (1 \times 2^{-2}) + (1 \times 2^{-3}) \\ &= (0 \times 1) + (1 \times 0.5) + (1 \times 0.25) + (1 \times 0.125) = (0.875)_{10} \end{aligned}$$

2.2: Octal-to-Decimal Conversion:-

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Ex. 7:- Convert the following octal number to decimal:-

a)  $(73)_8$

b)  $(31.6)_8$

Solution:-

a)  $(73)_8 \rightarrow (59)_{10}$

$\begin{array}{c} 1 \\ 8 \end{array} 8^0$

$7 \ 3$

$(7 \times 8^1) + (3 \times 8^0)$

$(7 \times 8) + (3 \times 1) = (59)_{10}$

b)  $(31.6)_8 \rightarrow (25.75)_{10}$

$\begin{array}{c} 1 \\ 8 \end{array} 8^0 \quad \begin{array}{c} 1 \\ 8 \end{array} 8^{-1}$

$3 \ 1 \ . \ 6$

$(3 \times 8^1) + (1 \times 8^0) + (6 \times 8^{-1})$

$(3 \times 8) + (1 \times 1) + (6 \times 0.125) = (25.75)_{10}$

2.3: Hexadecimal-to-Decimal Conversion:-Ex. 8:- Convert the following hexadecimal numbers to decimal:-

a)  $(1C)_{16}$

b)  $(F5.AB85)_{16}$

Solution:-

a)  $(1C)_{16} \rightarrow (28)_{10}$

$\begin{array}{c} 1 \\ 16 \end{array} 16^1$

$\begin{array}{c} 1 \\ 16 \end{array} 16^0$

$1 \ C$

$(1 \times 16^1) + (C \times 16^0)$

$(1 \times 16) + (12 \times 1) = (28)_{10}$

b)  $(F5.AB85)_{16} \rightarrow (245.67)_{10}$

$\begin{array}{c} 1 \\ 16 \end{array} 16^1$

$\begin{array}{c} 1 \\ 16 \end{array} 16^0$

$\begin{array}{c} 1 \\ 16 \end{array} 16^{-1}$

$\begin{array}{c} 1 \\ 16 \end{array} 16^{-2}$

$\begin{array}{c} 1 \\ 16 \end{array} 16^{-3}$

$\begin{array}{c} 1 \\ 16 \end{array} 16^{-4}$

$(F \times 16^1) + (5 \times 16^0) + (A \times 16^{-1}) + (B \times 16^{-2}) + (8 \times 16^{-3}) + (5 \times 16^{-4})$

$(15 \times 16) + (5 \times 1) + (10 \times 0.0625) + (11 \times 0.0039) + (8 \times 0.00024) + (5 \times 0.000015)$

$= (245.67)_{10}$