Chapter-1: NUMBER SYSTEM

1) What is bit, byte, nibble, word?

⇒

- A bit is the smallest unit of data that a computer can process and store.
- Byte is a unit of data that is eight binary digits long.
- Nibble refers to four consecutive binary digits or half of an 8-bit byte.
- Word is a unit of data used by a particular processor design. The size of a word can vary, typically 16, 32 or 64 bits, depending on the computer architecture.

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2) Convert $(89.567)_{10}$ into Binary, Octal and Hexadecimal.

⇒

First converting into Binary,

~~$(89.567)_{10}$ = 8X~~

2	89	1
2	44	0
2	22	0
2	11	1
2	5	1
2	2	0
2	1	1
	0	

$0.567 \times 2 = 1.134 = 1$

$0.134 \times 2 = 0.268 = 0$

$0.268 \times 2 = 0.536 = 0$

$0.536 \times 2 = 1.072 = 1$

$\therefore (89.567)_{10} = (1011001.1001)_2$

· <u>Converting to Octal</u>

$(1011001.1001)_2 \rightarrow (?)_8$

$= (131.41)_8$

$\therefore (89.567)_{10} = (131.44)_8$

· <u>Converting to Hexadecimal</u>

$(1011001.1001)_2 \rightarrow (?)_{16}$

$= (59.9)_{16}$

$\therefore (89.567)_{10} = (59.9)_{16}$

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3) Convert $(11111010011.110111101)_2$ into Decimal, Octal and Hexadecimal.

⇒

· <u>Converting to Decimal</u>

$1\times2^{10} + 1\times2^{9} + 1\times2^{8} + 1\times2^{7} + 1\times2^{6} + 0\times2^{5} + 1\times2^{4} + 1\times2^{3} + 0\times2^{2} + 0\times2^{1}$
$+ 1\times2^{0} + 1\times2^{-1} + 1\times2^{-2} + 0\times2^{-3} + 1\times2^{-4} + 1\times2^{-5} + 1\times2^{-6} + 1\times2^{-7}$
$0\times2^{-8} + 1\times2^{-9}$

$= (2009.869141)_{10}$

- Converting to Decimal

$1\times2^9+1\times2^8+1\times2^7+1\times2^6+1\times2^5+0\times2^4+1\times2^3+0\times2^2+0\times2^1+1\times2^0$
$+1\times2^{-1}+1\times2^{-2}+0\times2^{-3}+1\times2^{-4}+1\times2^{-5}+1\times2^{-6}+1\times2^{-7}+0\times2^{-8}+$
1×2^{-9}

$= (1001.869141)_{10}$

- Converting to Octal

$(1111101001.110111101)_2 \to (?)_8$

$= (1751.675)_8$

- Converting to Hexadecimal

$(1111101001.110111101)_2 \to (?)_{16}$

$= (3E9.DE8)_{16}$

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4) Convert $(61.534)_8$ into Decimal, Binary and Hexadecimal.

- Converting to Binary

$(61.534)_8 \to (?)_2$

$= (110\ 001.101\ 011\ 100)_2$

- Converting to Decimal

$(61.534)_8 \rightarrow (?)_{10}$

$= 6\times8^1 + 1\times8^0 + 5\times8^{-1} + 3\times8^{-2} + 4\times8^{-3}$

$= (49.6796875)_{10}$

- Converting to Hexadecimal

we have, $(61.534)_8 = (110001.101011100)_2$

$(110\ 001.\ 101011100)_2 \rightarrow (?)_{16}$

$= (31.AE0)_{16}$

5) Convert the $(AB6F.EDC2A)_{16}$ into Decimal, Binary and Octal.

- Converting to Decimal

$= 10\times16^3 + 11\times16^2 + 6\times16^1 + 15\times16^0 + 14\times16^{-1} + 13\times16^{-2} + 12\times16^{-3}$
$+ 2\times16^{-4} + 10\times16^{-5}$

$= (43887.92875)_{10}$

- Converting to Binary

$(AB6F.EDC2A)_{16} \rightarrow (?)_2$

$= (1010\ 1011\ 0110\ 1111.\ \cancel{1101}\ 1110\ 1101\ 1100\ 0010$
$1010)_2$

- Converting to Octal

We have, $(AB6F.EDC2A)_{16} = (1010101101101111.1110\ 1101\ 1100\ 0010\ 1010)_2$

$(1\ 010\ 101\ 101\ 101\ 111.111\ 011\ 011\ 100\ 001\ 010\ 100)_2 \to (?)_8$

$= (125557.733412 4)_8$

6) If A = 1101 and B = 1011 and both are binary numbers then find,

a) A + B b) A - B

For A + B

$$\begin{array}{r} 1101 \\ +\ 1011 \\ \hline 11000 \end{array}$$

For A - B

$$\begin{array}{r} 1101 \\ -\ 1011 \\ \hline 0010 \end{array}$$

7) Perform Octal Addition on $(356)_8 + (0.127)_8 + (67.243)_8$

We have,

$(356)_8 = (238)_{10}$

$(0.127)_8 = \cancel{(0.87)_{10}}\ (0.1699)_{10}$

$(67.243)_8 = (55.3183)_{10}$

$(238 + 0.1699 + 55.3183)_{10} = (293.4882)_{10}$

Then,

$(293.4482)_{10} = (445.3453)_8$

8) Perform Hexadecimal addition on $(DD)_{16} + (0.BF)_{16} + (C0.57)_{16}$

⇒

First, we convert all the hexadecimal numbers into decimal,

$(DD)_{16} = 13 \times 16^{1} + 13 \times 16^{0} = (221)_{10}$

$(0.BF)_{16} = 0 \times 16^{0} + 11 \times 16^{-1} + 15 \times 16^{-2} = (0.7460)_{10}$

$(C0.57)_{16} = 12 \times 16^{1} + 0 \times 16^{0} + 5 \times 16^{-1} + 7 \times 16^{-2} = (192.3398)_{10}$

Then,

$(DD)_{16} + (0.BF)_{16} + (C0.57)_{16} = (221)_{10} + (0.7460)_{10} + (192.3398)_{10}$
$= (414.0858)$
$= (195.15F6)$

9) Perform the subtraction using both R and R-1's complement method.

a) $(10111)_2 - (110000)_2$

we know,
r = base of number system

- for binary number system
  r = 2, so r's complement = 2's complement
  and (r-1)'s complement = (2-1) = 1's complement

Using 1's complement method

23	0	010111
-48	1	001111
-25	1	100110
	1	011001

$\therefore (10111)_2 - (110000)_2 = -(011001)_2$

Using 2's complement method

23	0	010111
-48	1	010000
-25	1	100111
	1	011001

$\therefore (10111)_2 - (110000)_2 = -(011001)_2$

b) $(11110111)_2 - (1100100)_2$

Using 1's complement method

+247	0	11110111
-100	1	10011011
+147	0	10010010
	+	1
	0	10010011

$\therefore (11110111)_2 - (1100100)_2 = (10010011)_2$

Using 2's complement

+247	0	11110111
-100	1	10011100
+147	0	1 10010011

Discard

$\therefore (11110111)_2 - (10011100)_2 = (10010011)_2$

10) Perform the subtraction: $(111101101)_2 - (11010100)_2$ using 2's complement method.

⇒

+493	0	111101101
-212	1	100101100
281	0	1 100011001

Discard

$\therefore (111101101)_2 - (11010100)_2 = (100011001)_2$

11) Subtract: $(123)_{10} - (222)_{10}$ using 2's complement method.

⇒

we have,

$(123)_{10} = (01111011)_2$

$(222)_{10} = (11011110)_2$

+123	0	01111011
-222	1	00100010
-99	1	10011101
	1	01100011

$\therefore (123)_{10} - (222)_{10} = -(99)_{10} = \cancel{(10011101)_2}$

$-(01100011)_2$

12) Perform Hexadecimal subtraction using 2's complement for $(75)_{16} - (21)_{16}$ and $(94)_{16} - (5C)_{16}$

⇒

For $(75)_{16} - (21)_{16}$

We have,

$(75)_{16} = (1110101)_2 = (117)_{10}$

$(21)_{16} = (0100001)_2 = (33)_{10}$

+117	0	1110101
−33	1	1011111
+84	0	1 1010100

↑ Discard

$\therefore (75)_{16} - (21)_{16} = (1010100)_2 = (54)_{16}$

For $(94)_{16} - (5C)_{16}$

We have,

$(94)_{16} = (10010100)_2 = (148)_{10}$

$(5C)_{16} = (01011100)_2 = (92)_{10}$

+148	0	10010100
−92	1	10100100
+56	0	1 00111000

↑ Discard

~~$\therefore (94)_{16} - (5C)_{16}$~~ $= (10111000)_2 = (B8)_{16}$

$\therefore (94)_{16} - (5C)_{16} = (111000)_2 = (38)_{16}$

13) Explain BCD, Gray and Alphanumeric Codes.

⇒

- **Binary Coded Decimal (BCD)**
  It is a simplex binary code used to represent decimal number into binary coded form. In BCD, each decimal number is represented with 4 bit equivalent binary number.

- **Gray Code**
  Gray code is the transition base code. In Gray Code, only one bit is interchanged during the transition in a sequence from previous transition.

- **Alpha-Numeric Code**
  An alphanumeric character set is a set of elements that includes 26 letter of alphabets, 10 decimal number and certein special symbols such as @, #, *, +, - etc. The standard alpha-numeric code is ASCII code. It uses 7-bit to represent its characters.

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14) Convert the following Binary code to Gray.

a) $(11010)_2$

↓

~~= (1001~~

$= (10111)_G$

b) $(10001)_2$

↓

$= (11001)_G$

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15) Convert the following Gray code into Binary.

a) $(11011)_{GRAY}$

$\downarrow$

$= (10010)_2$

b) $(10101)_{GRAY}$

$\downarrow$

$= (11001)_2$