Assignment - 1

1)
a) $(4310)_5 = (\ )_8 = (\ )_{BCD}$

$(4310)_5$ to decimal

$= 4 \times 5^3 + 3 \times 5^2 + 1 \times 5 + 0 \times 5^0$

$= (580)_{10}$

$(580)_{10}$ to octal.

$\frac{580}{8}$	72	4
$\frac{72}{8}$	9	0
$\frac{9}{8}$	1	1
$\frac{1}{8}$	0	1.

$= (1104)_8$

$(580)_{10}$ to BCD

$5 = \cancel{0101}.\ 0110$

$8 = 1000$

$0 = 0000$

$(580)_{10} = (0110\ 1000\ 0000)_{BCD}$

$$(4310)_5 = (1104)_8 = (0101\ 1000\ 0000)_{BCD}.$$

b) $(110.010)_{12} = (\quad)_2 = (\quad)_8.$

$$(110.010)_{12} = \left(1\times 144 + 12 + \frac{1}{12}\right)_{10}$$

$$= (156.00694)_{10}.$$

$$(156.00694)_{10} = (\quad)_2.$$

$2\,\lfloor 156$	78	0
$\frac{78}{2}$	39	0
$\frac{39}{2}$	19	1
$\frac{19}{2}$	9	1
$\frac{9}{2}$	4	1
$\frac{4}{2}$	2	0
$\frac{2}{2}$	1	0
$\frac{1}{2}$	0	1

$0.00694 \times 2 = 0.01388$ 0

$0.01388 \times 2 = 0.30536$ 0

$0.30536 \times 2 = 0.61072$ 0

$0.61072 \times 2 = 1.22144$ 1

$0.22144 \times 2 = 0.44288$ 0

$0.44288 \times 2 = 0.88576$ 0

$(156.00694)_{10} = (10011100.000100)_2.$

$(156.00694)_{10} = (\;)_8.$

$\frac{156}{8} = 19 \quad 4 =$

$\frac{19}{8} = 2 \quad 3$

$\frac{2}{8} = 0 \quad 2.$

$0.00694 \times 8 = 0.0552$ 0

$0.0552 \times 8 = 0.44416$ 0

$0.44416 \times 8 = 3.55328$ 3

$0.55328 \times 8 = 4.42624$ 4

$0.42624 \times 8 = 3.40992$ 3

$= (156.00694)_{10} = (234.34300)_8$

$(110.D10)_{12} = (10011100.000100)_2$

$= (234.34300)_8$.

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c) $(DADA.B)_{16} = (\ )_5$

$(DADA.B)_{16} = \left(16^3 \times 13 + 10 \times 16^2 + 13 \times 16 + 10 + \frac{11}{16}\right)_{10}$

$= (56026.6875)_{10}$.

$\frac{56026}{5}$ 11205 = 1

$\frac{11205}{5}$ 2241 = 0

$\frac{2241}{5}$ 448

$\frac{448}{5}$ 89 3

$\frac{89}{5}$ 17 4

$\frac{17}{5}$	3	2
$\frac{3}{5}$	0	3

$0.6875 \times 5 =$	3.4375		3
$0.4375 \times 5 =$	2.1875		2
$0.1875 \times 5 =$	0.9375		0
$0.9375 \times 5 =$	4.6875		4
$0.6875 \times 5 =$	3.4375		3

$$(DADA.B)_{16} = (3243101.32043)_5.$$

Assignment - 1.

2) Evaluate 9's and 10's complement of 54760, 003497.

i) $N = 54760$ - 9's complement $= (r^n - 1) - N$

$n = 5 \quad r = 10$

$= (10^5 - 1) - 54760$

$= 100000 - 54761$

$= 45239$

10's complement $- (r^n) - N$

$= 10^5 - 54760$

$= 45240.$

ii) $N = 003497$ - 9's complement $= (r^n - 1) - N$

$n = 4 \quad r = 10$

$= (10^4 - 1) - 003497$

$= (10000 - 1) - 3497$

$= 10000 - 3498$

$= 6502$

10's complement $= r^n - N$

$= 10000 - 3497$

$= 6503.$

3) 2's complement of 1001100 and 0011010

i) 1001100

1's complement - ~~1001~~ 0110011

2's complement - 0110011

$$\begin{array}{r} 0110011 \\ +\quad\quad 1 \\ \hline 0110100 \\ \hline \end{array}$$

= 2's complement = 0110100

ii) 2's complement of 0011010

1's complement - 1100101

2's complement - 1100101

$$\begin{array}{r} 1100101 \\ +\quad\quad 1 \\ \hline 1100110 \end{array}$$

= 1100110.

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4) X = 1011100

Y = 1001011.

i) X - Y

X + (-Y)

-Y = 2's complement of Y

1's complement of Y = 0110100

2's complement of Y = 0110100

$$\begin{array}{r} 0110100 \\ +\quad\quad 1 \\ \hline 0110101 \end{array}$$

$$\begin{array}{rr} X + (-Y) = & 1011100 \\ & +\ 0110101 \\ \hline & 1\ 0010001 \end{array}$$

Discard

X - Y = 0010001

$x - y = 0010001.$

ii) $y - x$

$y + (-x)$

$-x$ = 2's complement of x

1's complement = 0100011

2's complement of x = 0100011

$$\begin{array}{r} 0100011 \\ +\quad 1 \\ \hline 0100100 \end{array}$$

$$\begin{array}{rr} y - x = & 1001011 \\ + & 0100100 \\ \hline & 1101111 \end{array}$$

No discard carry, so find 2's complement of ans and make -ve

2's complement of 1101111 =

1's complement = 0010000

2's complement = 0010000

$$\begin{array}{r} 0010000 \\ +\quad 1 \\ \hline 0010001 \end{array}$$

Ans: $y - x = -(0010001).$

iii) $-x - y$

$= -x + (-y)$

$=$ 2's complement of x + 2's complement of y

2's complement of x = 0100100

2's complement of y = 0110101

$$
\begin{array}{r}
= 0100100 \\
+\ 0110101 \\
\hline
1011001 \\
\hline
\end{array}
$$

No carry, find 2's complement and find -ve.

2's complement = 1's complement + 1.

1's complement = 0100110

$$
\begin{array}{rr}
\text{2's complement} = & 0100110 \\
& +\ \ \ \ \ \ 1 \\
\hline
& 0100111 \\
\hline
\end{array}
$$

$-x - y = -(0100111)$

5) BCD addition

a) $X = 0100$, $Y = 0101$.

$$
\begin{array}{r}
= 0100 \\
+\ 0101 \\
\hline
1001 \\
\hline
\end{array}
$$

$X+Y = (1001)_{BCD}$

b) $X = 1000$, $Y = 1001$

$$
\begin{array}{r}
= 1000 \\
1001 \\
\hline
10001 \\
\hline
\end{array}
$$

– greater than 1001 so add 6.

$$
\begin{array}{r}
= 10001 \\
+\ \ 0110 \\
\hline
10111 \\
\hline
+\ \ 0110 \\
\hline
{}^{1}11101 \\
+\ \ 0110 \\
\hline
100011 \\
\end{array}
$$

$X+Y = (00010111)_{BCD}$

b) $(+49)_{10} = \frac{49}{2} = 24 + \frac{1}{2} = (110001)_2$

$\frac{24}{2} = 12 + \frac{0}{2}$.

$\frac{12}{2} = 6 + \frac{0}{2}$.

$\frac{6}{2} = 3 + \frac{0}{2}$.

$\frac{3}{2} = 1 + \frac{1}{2}$.

$\frac{1}{2} = 0 + \frac{1}{2}$.

$(+29)_{10} = \frac{29}{2} = 14 + \frac{1}{2} = (11101)_2$.

$\frac{14}{2} = 7 + \frac{0}{2}$.

$\frac{7}{2} = 3 + \frac{1}{2}$.

$\frac{3}{2} = 1 + \frac{1}{2}$.

$\frac{1}{2} = 0 + \frac{1}{2}$

$(+49)_{10} = 00110001$

$(+29)_{10} = 00011101$

$$(-49)_{10} = \begin{array}{r} 11001110 \\ +\quad 1 \\ \hline 11001111 \end{array}$$

$(-49)_{10} = 11001111.$

$$(-29)_{10} = \begin{array}{r} 11100010 \\ +\quad 1 \\ \hline 11100011 \end{array}$$

$(-29)_{10} = 11100011.$

$$(+29) + (-49) = \begin{array}{r} {\scriptstyle 1\,1\,1\,1\ \ } \\ 00011101 \\ +\ 11001111 \\ \hline 11101100 \end{array}$$

$$\text{2's complement} = \begin{array}{r} 00010011 \\ +\quad 1 \\ \hline 00010100 \end{array}$$

$(+29) + (-49) = -(00010100)_2$.

$-(00010100)_2 = (-10)_{10} = (+29) + (-49)$

verified.

ii) $(-29) + (+49)$

$$
\begin{array}{r}
= 11100011 \\
+\ 00110001 \\
\hline
1\,00010100
\end{array}
$$

Discard.

Ans $= (00010100)_2 = (10)_2$.

$49 - 29 = 10$

verified.

iii) $(-29) + (-49)$

$$
\begin{array}{r}
= 11100011 \\
+\ 11001111 \\
\hline
110110010
\end{array}
$$

2's complement of 10110010

$$
\begin{array}{r}
= 01001101 \\
+\ \ \ \ \ \ \ \ \ 1 \\
\hline
01001110
\end{array}
$$

$(-29)+(-49) = -(0\overset{1}{0}001110)_2 =$

Ans $= -(01001110)_2 = (-78)_{10}$

$1\times2^6 + 1\times2^3 + 1\times2^2 + 1\times2^1 = 78$

verified

7) (a) 16's complement of 3DF.

15's complement of 3DF

$$\begin{array}{r} = \text{F F F} \\ -\ \text{3 D F} \\ \hline \text{C 2 0} \end{array}$$

16's complement $=$

$$\begin{array}{r} \text{C 2 0} \\ +\ \ 1 \\ \hline \text{C 2 1} \end{array}$$

(b) C3DF to binary.

$(C3DF)_{16} = 12\times16^3 + 3\times16^2 + 13\times16 + 15\times16^0$

$= (50143)_{10}$.

c) $\frac{50143}{2} = 25071$ 1

$\frac{25071}{2} = 12535$ 1

$\frac{12535}{2} = 6267$ 1

$\frac{6267}{2}$ 3133   1

$\frac{3133}{2}$ 1566   1

$\frac{1566}{2}$ 783   0

$\frac{783}{2}$ 391   1.

$\frac{391}{2}$ 195   1

$\frac{195}{2}$ 97   1

$\frac{97}{2}$ 48   1

$\frac{48}{2}$ 24   0

$\frac{24}{2}$ 12   0

$\frac{12}{2}$	6	0
$\frac{6}{2}$	3	0
$\frac{3}{2}$	1	1
$\frac{1}{2}$	0	1

$(50143)_2 = (11\,0000\,1111\,01\,1111)_2$

2's complement $= 0011110000100000$

$$\begin{array}{r} 0011110000100000 \\ +\quad\quad\quad\quad\quad\quad 1 \\ \hline 0011110000100001 \end{array}$$

2's complement $= (0011\,110000\,100001)_2$.

d)

$= (0011\ 1100\ 0010\ 0001)$

$= (3\ C\ 2\ 1)_{16}$

$(C3DF)_2$ is connected with $(3C21)_{16}$

$(3C21)_{16}$ is $(C3DF)_{16}$'s 16's complement.

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8) $111011 \div 101$.

```
          1011
     ________
101 ) 111011
     -101↓
     -----
      01001
     -0000
     -----
       1001
        101
     -----
       1001
        101
     -----
        100
```

Quotient = 1011

Remainder = 100

9)

1 1 1 0 1 1

× 1 0 1

1 1

1 1 1 0 1 1

0 0 0 0 0 0 +

1 1 1 0 1 1 + +

1 0 0 1 0 0 1 1 1

Discard

Ans: 111011 × 101 = 100100111.

10) $x^2 - 11x + 12 = 0.$

Zeroes = 3 and 6.

Sum of Zeroes = 9

product = 18.

Let the base be x.

Then for sum for equation

sum = $(11)_x$ to decimal

$= 1 \times x^1 + x^0 \times 1$

Sum = $x+1$

But sum = 9

$x+1 = 9$ $\quad x = 8$

product $= (\overset{22.}{\cancel{18}})_x = (2x+2)_{10}$

product $= (2x+2)_{10} = (18)_{10}$

$2x+2 = 18$

$x = 8.$

Base $= 8.$