Assignment - 1

Q1 Convert :- Binary to Decimal.

a) $(100)_2$

$= 1 \times 2^2 + 0 \times 2^1 + 0 \times 2^0$

$= (4)_{10}$

b) $(11010)_2$

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

$= 0 + 2 + 0 + 8 + 16$

$= (26)_{10}$

c) $(10110010)_2$

$0 \times 2^0 = 0$

$1 \times 2^1 = 2$

$0 \times 2^2 = 0$

$0 \times 2^3 = 0$

$1 \times 2^4 = 16$

$1 \times 2^5 = 32$

$0 \times 2^6 = 0$

$1 \times 2^7 = 128$

$2 + 16 + 32 + 128 = (178)_{10}$

d) $(1.001)_2$

$1 \times 2^0 + 0 \times 2^{-1} + 0 \times 2^{-2} + 1 \times 2^{-3} = 1 + \frac{1}{8} = \frac{9}{8}$

$= (1.125)_{10}$

e) $(110100 . 010011)_2$

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

$= 0 + 0 + 4 + 0 + 16 + 32 + 0 + 0.250 + 0 + 0 + 0.031 + 0.015$

$= (52.2960)_{10}$

f) $(11010 . 10110)_2$

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

$= 0 + 2 + 0 + 8 + 16 + 0.5 + 0 + 0.125 + 0.0625 + 0$

$= 26 + 0.6875$

$= (26.6875)_{10}$

g) $(1000001 . 111)_2$

$= 1 \times 2^0 + 0 + 2^1 + 0 \times 2^2 + 0 \times 2^3 + 0 \times 2^4 + 0 \times 25 + 1 \times 2^6 + 1 \times 2^{-1} + 1 \times 2^{-2} + 1 \times 2^{-3}$.

$= 1 + 0 + 0 + 0 + 0 + 0 + 64 + 0.5 + 0.25 + 0.125$

$= 65 + 0.875$

$= (65.875)_{10}$

Q2 Convert :- Decimal to Binary.

a) 16

2	16	– 0
2	8	– 0
2	4	– 0
2	2	– 0
	1	

$(16)_{10} = (10000)_2$

b) 247

2	247	
2	123	– 1
2	61	– 1
2	30	– 1
2	15	– 0
2	7	– 1
2	3	– 1
	1	– 1

$(247)_{10} = (11110111)_2$

2) 962.84.

2	962	– 0
2	481	– 1
2	240	– 1
2	120	– 0
2	60	– 0
2	30	– 0
2	15	– 0
2	7	– 1
2	3	– 1
2	1	– 1

$0.84 \times 2 = 1.68 \rightarrow 1$

$0.68 \times 2 = 1.36 - 1$

$0.36 \times 2 = 0.72 - 0$

$0.72 \times 2 = 1.44 - 1$

$(962.84)_{10} =$

$(1111\ 000010.1101)_2$

d) $(0.0132)_{10}$

$0.132 \times 2 = 0.0264 \rightarrow 0$

$0.0264 \times 2 = 0.0528 \rightarrow 0$

$0.0528 \times 2 = 0.1056 \rightarrow 0$

$0.1056 \times 2 = 0.2112 \rightarrow 0$

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$0.2112 \times 2 = 0.4224 \rightarrow 0$
$0.4224 + 2 = 0.8448 \rightarrow 0$
$0.8448 \times 2 = 1.6896 \rightarrow 1$
$0.6896 \times 2 = 1.3792 \rightarrow 1$

$(0.132)_{10} = (0.00000011)_2$

c) $(6.74)_{10}$

$2 \overline{)6}$
$2 \overline{)3} - 0$
$1 \quad -1$

$0.74 \times 2 = 1.48 \rightarrow 1$
$0.48 \times 2 = 0.96 \rightarrow 0$
$0.96 \times 2 = 1.92 \rightarrow 1$
$0.92 \times 2 = 1.84 \rightarrow 1$

$(6.74)_{10} = (110.1011)_2$

Q3 convert :- octal to decimal.

a. $(14)_8$.

$= 1 \times 8^1 + 4 \times 8^0$
$= 8 + 4$
$= (12)_{10}$

b) $(236)_8$

$= 2 \times 8^2 + 3 \times 8^1 + 6 \times 8^0$
$= 128 + 24 + 6$
$= (158)_{10}$

c) $(1432)_8$

$= 1 \times 8^3 + 4 \times 8^2 + 3 \times 8^1 + 2 \times 8^0$

$= 512 + 256 + 24 + 2$

$= (794)_{10}$

d) $(0.43)_8$

$= 4 \times 8^{-1} + 3 \times 8^{-2}$

$= 4/8 + 3/64$

$= 0.5 + .0468$

$= (0.5468)_{10}$

e) $(0.254)_8$.

$= 2 \times 8^{-1} + 5 \times 8^{-2} + 4 \times 8^{-3}$

$= 2/8 + 5/64 + 4/512$

$= 0.25 + 0.0781 + 0.0078$

$= (0.3359)_{10}$

g) $(206.104)_8$

$= 2 \times 8^{-2} + 0 \times 8^1 + 6 \times 8^0 + 1 \times 8^{-1} + 0 \times 8^{-2}$
$+ 4 \times 8^{-3}$

$= 128 + 0 + 6 + 0.125 + 0 + 0.008 -$

$= 128 + 6 + 0.125 + 0.0078$

$= (134.1328)_{10}$

Q4 convert :- decimal to octal

a) $(29)_{10}$

8 | 29
3 — 5

$(35)_8$

b) $(68)_{10}$

8 | 68
8 | 8 — 4
1 — 0

$(104)_8$

c) $(125)_{10}$

8 | 125
8 | 15 — 5
1 — 7

$(175)_8$

d) $(243.67)_{10}$

8 | 243
8 | 30 — 3
3 — 6

$(368.52702)_8$

e) $(419.95)_{10}$

8 | 419
8 | 52 — 3
6 — 4

$0.45 \times 8 = 76 \rightarrow 7$
$0.6 \times 8 = 4.8 \rightarrow 4$
$0.8 \times 8 = 6.4 \rightarrow 6$
$0.4 \times 8 = 3.2 \rightarrow 6^2$

$(643.7463)_8$

f) $(645.7)_{10}$

8 | 645
8 | 80 — 5
8 | 10 — 0
1 — 2

$0.7 \times 8 = 5.6 \Rightarrow 5$
$0.6 \times 8 = 4.8 \rightarrow 4$
$0.8 \times 8 = 6.4 \rightarrow 6$
$0.4 \times 8 = 3.2 \Rightarrow 3$

$(1205.5463)_8$

g) $(39.4475)_{10}$

$8 \overline{)39}$ — 7
$\quad 4$

$0.4475 \times 8 = 3.58 \rightarrow 3$

$0.58 \times 8 = 4.64 \rightarrow 4$

$0.64 \times 8 = 5.12 \rightarrow 5$

$0.12 \times 8 = 0.96 \rightarrow 0$

$0.96 \times 8 = 7.68 \rightarrow 7$

$(47.34507)_8$

h) $(49.21875)_{10}$.

$8 \overline{)49}$
$\quad 6$ — 1

$0.21875 \times 8 = 1.75 \rightarrow 1$

$0.75 \times 8 = 6 \rightarrow 1$

$(61.16)_8$

Q8 convert :- ~~Binary to~~ octal to Binary

a) $(13)_8$

1	3
001	011

$(13)_8 = (001\ 011)_2$

b) $(27)_8$

2	7
010	111

$(27)_8 = (010111)_2$

c) $(65)_8$

6 5

110 101

$(65)_8 = (1101017)_2$

d) $(124.375)_8$

1 2 4 . 3 7 5

001 010 100 . 011 111 101

$(124.375)_8 = (001010100.011111101)_2$

e) $(217.436)_8$

2 1 7 . 4 3 6

010 001 111 100 011 110

$(217.436)_8 = (010001111.100011110)_2$

Q6 convert :- Binary to octal.

a) $(10110010)_2$

10110010

$= (262)_{10}$

b) $(10101101)_2$

$= 10101101$

$= (255)_8$

c) $(1110101)_2$

1110101

$= (165)_{10}$

d) $(10111.101)_2$

(10111.101)

$= (27.5)_{10}$

e) $(111010.001)_2$

111010.001

$= (72.1)_{10}$

Q7 Convert 18 × 24 to Binary form & perform binary multiplication

2	18	
2	9	– 0
2	4	– 1
2	2	– 0
	1	– 0

$(18)_{10} = (10010)_2$

8	24	
2	12	– 0
2	6	– 0
2	3	– 0
	1	– 1

$(24)_{10} = (11000)_2$

Binary multiplication

```
      10010
      11000
    -------
      00000
     00000x
    00000xx
   00000xxx
  10010xxxx
  --------
  110110000
```

Ans → $(110110000)_2 = (432)_{10}$

Q8 Convert 58.75 ÷ 23.5 to Binary form & then perform operation.

$(58.75)_{10}$

2 | 58
2 | 29 — 0
2 | 14 — 1
2 | 7 — 0
2 | 3 — 1
1 — 1

$(23.5)_{10}$

2 | 23
2 | 11 — 1
2 | 5 — 1
2 | 2 — 1
1 — 0

$0.5 \times 2 = 1$

$0.75 \times 2 = 1.5 \rightarrow 1$
$0.5 \times 2 = 1 \rightarrow 1$

$(23.5) = 10111.1$

$(58.75)_{10} = 111010.11$ $(23.5) = 10111.1$

```
101111 ) 1110101.1 ( 10.1
         101111
         -------
          101111
         -101111
         -------
              X
```

$\therefore (111010.11)_2 \div (10111.1) = (10.1)_2$

Q9 Add the following binary numbers :-

a) $\begin{array}{r} 11 \\ +\ 11 \\ \hline 110 \end{array}$

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

c) $\begin{array}{r} 101011 \\ +\ 110101 \\ \hline 1100000 \end{array}$

d) 1110101
101 1111
11010100

Q10 Add the following binary numbers:

a) ~~1~~ 1011
~~−0~~ + 1101
10000

b) 1010110
1110101
1001010
1010001 1

c) 1010110
1111011
+ 1011111
110000010

d) 10110110
11010101
+ 11010110
110000100 1

Q11 Subtract -

a) 11
10
$(01)_2$

b) 111
101
$(010)_2$

c) 101011
10 0101
$(000110)_2$

d) 11100001
10011110
$(01000011)_2$

Q12 Multiply the following :-

a) 11 × 11

$$\begin{array}{r} 11 \\ \times\ 11 \\ \hline 11 \\ 11\times \\ \hline (1001)_2 \end{array}$$

b) 101×10

$$\begin{array}{r} 101 \\ \times\ 10 \\ \hline 000 \\ 101\times \\ \hline (1010)_2 \end{array}$$

c) 110×101

$$\begin{array}{r} 110 \\ 101 \\ \hline 110 \\ 000\times \\ 110\times\times \\ \hline (11110)_2 \end{array}$$

d) 1011×1101

$$\begin{array}{r} 1011 \\ \times\ 1011 \\ \hline 1011 \\ 1011\times \\ 0000\times\times \\ 1011\times\times\times \\ \hline (11111001)_2 \end{array}$$

e) 1010×101

$$\begin{array}{r} 1010 \\ 101 \\ \hline 1010 \\ 0000\times \\ 1010\times\times \\ \hline (110010)_2 \end{array}$$

Q13 Divide :-

a) ~~110 ÷~~ $110 \div 10$

$$\begin{array}{r} 11 \\ 10\overline{)110} \\ 10 \\ \hline 10 \\ -10 \\ \hline \end{array}$$

b) $10110 \div 10$

$$\begin{array}{r} 1011 \\ 10\overline{)10110} \\ -10 \\ \hline 011 \\ -10 \\ \hline 10 \\ -10 \\ \hline \end{array}$$

c) 101101 ÷ 11

⇒ 1011010 ÷ 11

```
      11110
11 ) 101101
     111
      101
      - 11
        100
        - 11
          11
          - 11
           00
           - 0
             x
```

$(11110)_2$

d) 11001.11 ÷ 1101

```
1101 ) 11001.11 ( 1.1111
       - 1101
         11001
       - 1101
         11001
          1101
         11000
       - 1101
         11000
       - 1101
         10110
       - 1101
          1001
```

$(1.1111)_2$

Q14 Perform subtraction op. indicated below using adder and the two's complement of the ~~sto~~ subtrahend.

a) $(100101)_2 - (110011)_2$

1's complement of $(011011)_2 \rightarrow (100100)_2$

2's complement = 100100.
+ 1
100101

$(100101)_2 - (011011)_2 = (100101)_2 + (100101)_2$

100101
100101
1001010 We can discard the carry!

∴ Result is $(1010)_2$

b) $(1101011)_2 - (111010)_2$

1's complement of $(01111010)_2 \rightarrow (1000101)_2$

2's complement → 1000101
+ 1
$(1000110)_2$

$(1101011)_2 - (011010)_2 - (110 10 11)_2 + (100110)_2$

$$\begin{array}{r} 1101011 \\ 1000110 \\ \hline 10110001 \end{array}$$

We can discard the carry,

$\therefore$ Result is $(110001)_2$

c) $(1101111)_2 - (10110111)_2$

1's complement of $(10110111)_2 \Rightarrow (01001000)_2$

2's complement $\Rightarrow$

$$\begin{array}{r} 01001000 \\ +1 \\ \hline (01001001)_2 \end{array}$$

$(1110111)_2 - (10110111)_2 = (1110111)_2 + (01001001)_2$

$$\begin{array}{r} 01110111 \\ 01001001 \\ \hline (11000000)_2 \end{array}$$

We didn't get any carry

~~We~~

The final result is the 2's complement of $(11000000)_2$

$$\begin{array}{r} 00111111 \\ +1 \\ \hline 1000000 \end{array}$$

Result is $(-1000000)_2$

Q15 Write the following decimal numbers in eight bit two's complement, do the addition/subtraction, convert your answer back to decimal.

a) $-3 + +11$

8 bit binary representation of $3 = (00000011)_2$

1's complement $= (11111100)_2$

2's complement $=$ 11111100
+1

Add 11 → 00001011

100001001

We can discard the carry!

∴ Result is $(1000)_2 = 1 \times 2^3 = (8)_{10}$

b) $+125 + -40$

8 bit representation of 40 → $(00101000)_2$

1's complement → $(11010111)_2$

2's complement → +1

$(11011000)_2$

Add 12 → 110110 00
011111 01

10101001

We can discard the carry!

$\therefore$ Result is $(1010101)_2$

$= 1 \times 2^6 + 1 \times 2^4 + 1 \times 2^2 + 1 \times 2^0$

$= 64 + 16 + 4 + 1$

$= (85)_{10}$