# ASSIGNMENT - 01

1) Convert the following

(a) $10111101.0101_{(2)} = (\ )_{(10)}$

$\Rightarrow$ $10111101.0101$

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

$= 1\times128 + 0\times64 + 1\times32 + 1\times16 + 1\times8 + 1\times4 + 0\times2 + 1\times1 + 0\times0.5$
$1\times0.25 + 0\times0.125 + 1\times0.0625$

$= 128 + 0 + 32 + 16 + 8 + 4 + 0 + 1 + 0 + 0.25 + 0 + 0.0625$

$= 189.3125_{(10)}$

(b) $1101101_{(2)} = (\ )_{(10)}$

$\Rightarrow$ $1101101$

$= 1\times2^6 + 1\times2^5 + 0\times2^4 + 1\times2^3 + 1\times2^2 + 0\times2^1 + 1\times2^0$

$= 64 + 32 + 0 + 8 + 4 + 0 + 1$

$= 109_{(10)}$

(c) $10110001101011.11110010_{(2)} = (\ )_{(16)}$

$\Rightarrow$ $0010|1100|0110|1011.1111|0010$

$=$ 2 12 6 11 . 15 2

$= 2C6B.F2_{(16)}$

(d) $10110001101011.11110000110_{(2)} = (\ )_{(8)}$

$\Rightarrow$ $010|110|001|101|011.111|100|000|110$

$=$ 2 6 1 5 3 . 7 4 0 6

$= 26153.7406_{(8)}$

(e) $642.71_{(8)} = (\ )_{(2)}$

$\Rightarrow$ $= 6 \quad 4 \quad 2 \,.\, 7 \quad 1$

$= 110 \quad 100 \quad 010 \quad 111 \quad 001$

$= 110100010.111001_{(2)}$

(f) $1062.403_{(8)} = (\ )_{(10)}$

$\Rightarrow$

$1062.403$

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

$= 512 + 0 + 48 + 2 + 0.5 + 0 + 3\times 1.95\times 10^{-3}$

$= 562.50585_{(10)}$

(g) $237_{(8)} = (\ )_{(16)}$

$\Rightarrow$ $2 \; 3 \; 7$

$= 010011111$

$= 09 \quad 15$

$= 09F_{(16)}$

(h) $172.625_{(10)} = (\ )_{(2)}$

$\Rightarrow$ $172.625$

2 | 172
2 | 86 − 0
2 | 43 − 0
2 | 21 − 1
2 | 10 − 1
2 | 5 − 0
2 | 2 − 1
1 − 0

$172 = 10101100$

$0.625 \times 2 = 1.25 \rightarrow 1$
$0.25 \times 2 = 0.5 \rightarrow 0$
$0.5 \times 2 = 1.0 \rightarrow 1$

$\therefore 172.625_{(10)} = 10101100.101_{(2)}$

(i) $96_{(10)} = (\ )_{(2)}$

$\Rightarrow$

| | | |
|---|---|---|
| 2 | 96 | |
| 2 | 48 | - 0 |
| 2 | 24 | - 0 |
| 2 | 12 | - 0 |
| 2 | 6 | - 0 |
| 2 | 3 | - 0 |
| | 1 | - 1 |

$96_{(10)} = 1100000_{(2)}$

(j) $0.6875_{(10)} = (\ )_{(2)}$

$\Rightarrow$

$0.6875 \times 2 = 1.375 \rightarrow 1$
$0.375 \times 2 = 0.75 \rightarrow 0$
$0.75 \times 2 = 1.5 \rightarrow 1$
$0.5 \times 2 = 1.0 \rightarrow 1$

$\therefore 0.6875_{(10)} = 0.1011_{(2)}$

(k) $0.513_{(10)} = (\ )_{(8)}$

$\Rightarrow$

$0.513 \times 8 = 4.1040 \longrightarrow 4$

$0.1040 \times 8 = 0.8320 \longrightarrow 0$

$0.8320 \times 8 = 6.6560 \longrightarrow 6$

$0.6560 \times 8 = 5.2480 \longrightarrow 5$

$0.513_{(10)} = 0.4065_{(8)}$

(l) $49.5_{(10)} = (\ )_{(16)}$

$\Rightarrow$

16 | 49
  | 3 — 1

$0.5 \times 16 = 8.0 \longrightarrow 8$

$0 \times 16 = 0.0 \longrightarrow 0$

$49.5_{(10)} = 31.80_{(16)}$

(m) $ABCD.72_{(16)} = (\ )_{(8)}$

$\Rightarrow$

$ABCD.72 = 001|010|101|111|001|101.011|100|100$

$= 125715.044_{(8)}$

(n) $FA876_{(16)} = (\ )_{(8)}$

$\Rightarrow$

$FA876 = 011|111|010|100|001|110|110$

$= 3724166_{(8)}$

(o) $A59C.3A_{(16)} = (\ )_{(10)}$

$\Rightarrow$ $A59C.3A$

$= A\times16^3 + 5\times16^2 + 9\times16^1 + C\times16^0 + 3\times16^{-1} + A\times16^{-2}$

$= 10\times16^3 + 5\times16^2 + 9\times16^1 + 12\times16^0 + 3\times16^{-1} + 10\times16^{-2}$

$= 40960 + 1280 + 144 + 12 + 0.1875 + 0.0390625$

$= 42396.22656_{(10)}$

(p) $1AD.E0_{(16)} = (\ )_{(10)} = (\ )_{(8)}$

$\Rightarrow$ $1AD.E0 = 1\times16^2 + A\times16^1 + D\times16^0 + E\times16^{-1} + 0\times16^{-2}$

$= 1\times256 + 10\times16 + \times1 + 14\times0.0625 + 0$

$= 429.875_{(10)}$

$429.875_{(10)} = (\ )_{(8)}$

$$\begin{array}{r|l} 8 & 429 \\ \hline 8 & 53 - 5 \\ \hline & 6 - 5 \end{array}$$

$0.875 \times 8 = 7.0 \rightarrow 7$

$0.0 \times 8 = 0 \rightarrow 0$

$429.875_{(10)} = 655.70_{(8)}$

(q) $526.44_{(8)} = (\ )_{(2)} = (\ )_{(10)}$

$\Rightarrow$ $526.44_{(8)} = 101010110.100100_{(2)}$

$101010110.100100$

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

$= 256 + 0 + 64 + 0 + 16 + 0 + 4 + 1 + 0 + 0.5 + 0 + 0 + 0.0625 + 0 + 0$

$= 341.5625_{(10)}$

(4) $48350_{(10)} = (\ )_{(16)} = (\ )_{(8)}$

⇒

$$
\begin{array}{r|l}
16 & 48350 \\
16 & 3021 - 14 \\
16 & 188 - 13 \\
 & 11 - 12
\end{array}
$$

$48350_{(10)} = 11\ 12\ 13\ 14$

$= BCDE_{(16)}$

$BCDE_{(16)} = 001|011|110|011|011|110$

$= 136336_{(8)}$

(5) $342.56_{(10)} = (\ )_{(2)} = (\ )_{(8)}$

⇒

$$
\begin{array}{r|l}
2 & 342 \\
2 & 171 - 0 \\
2 & 85 - 1 \\
2 & 42 - 1 \\
2 & 21 - 0 \\
2 & 10 - 1 \\
2 & 5 - 0 \\
2 & 2 - 1 \\
 & 1 - 0
\end{array}
$$

$0.56 \times 2 = 1.12 \rightarrow 1$

$0.12 \times 2 = 0.24 \rightarrow 0$

$0.24 \times 2 = 0.48 \rightarrow 0$

$0.48 \times 2 = 0.96 \rightarrow 0$

$342.56_{(10)} = 101010110.1000_{(2)}$

101|010|110.100|000 = $526.40_{(8)}$

(t) $BCDE_{(16)} = (\quad)_{(2)} = (\quad)_{(8)}$

⇒ $BCDE_{(16)} = 1011110011011110_{(2)}$

$001|011|110|011|011|110_{(2)} = 136336_{(8)}$

2) Using 10's complement subtract

(i) 72532 − 3250

⇒ To match the bits,

3250 = 03250

9's complement of 03250

$$\begin{array}{r} 99999 \\ -\ 03250 \\ \hline 96749 \end{array}$$

10's complement of 03250 = 9's complement +1

= 96749 +1

= 96750

$$\begin{array}{r} 72532 \\ +\ 96750 \\ \hline \boxed{1}69282 \end{array}$$

∴ 72532 − 3250 = 69282

D D M M Y Y

(ii) 3250 − 72532

⇒ 9's complement of 72532

$$\begin{array}{r} 99999 \\ -\ 72532 \\ \hline 27467 \end{array}$$

10's complement of 72532 = 9's complement + 1

= 27467 + 1

= 27468

$$\begin{array}{r} 03250 \\ +\ 27468 \\ \hline \boxed{\times}\ 30718 \end{array}$$

Since there is no end around carry

− (10's complment of 30718)

= − (9's complement + 1)

=

$$\begin{array}{r} 99999 \\ -\ 30718 \\ \hline 69281 \end{array}$$

= − (69281 + 1)

= − 69282 //

3) Given the two binary numbers X = 1010100 and Y = 1000011, perform the subtraction

(a) X − Y and (b) Y − X using 2's complement

⇒ X − Y

1's complement of Y = 0111100

+ 0000001

0111101

X ⇒ 1010100

Y ⇒ 0111101

$\boxed{1}$0010001

X − Y using 2's complement is 0010001

Y − X

1's complement of X = 0101011

+ 0000001

0101100

Y ⇒ 1000011

X ⇒ 0101100

$\boxed{\times}$1101111

− (2's complement of 1101111)

− 1101111

0000001

− 1110000

Y − X using 2's complement = − 1110000

(c) X−Y and (d) Y−X using 1's complement

⇒ X−Y

1's complement of Y = 0111100

$$
\begin{array}{rl}
X \Rightarrow & 1010100 \\
Y \Rightarrow + & 0111100 \\
\hline
& \boxed{1}0010000 \\
& \quad\quad\quad\quad 1 \\
\hline
& 0010001
\end{array}
$$

X−Y using 1's complement = 0010001

Y−X

1's complement of X = 0101011

$$
\begin{array}{rl}
Y \Rightarrow & 1000011 \\
X \Rightarrow + & 0101011 \\
\hline
& \boxed{\times}1101110
\end{array}
$$

−(1's complement of 1101110)
= −0010001

4) Subtract $19_{(10)}$ from $15_{(10)}$ using 1's and 2's complement method

⇒ $19_{(10)} = (\quad)_{(2)}$

$$
\begin{array}{r|ll}
2 & 19 & \\
\hline
2 & 9 & -1 \\
\hline
2 & 4 & -1 \\
\hline
2 & 2 & -0 \\
\hline
 & 1 & -0
\end{array}
$$

$19_{(10)} = 10011_{(2)}$

$15_{(10)} = (\ )_{(2)}$

$$\begin{array}{r|l} 2 & 15 \\ 2 & 7 - 1 \\ 2 & 3 - 1 \\ & 1 - 1 \end{array}$$

$15_{(10)} = 1111_{(2)}$

$15_{(10)} - 19_{(10)}$ using 1's complement

1's complement 19, 10011 = 01100

$$\begin{array}{r} 01100 \\ + \quad\quad 1 \\ \hline \cancel{01101} \end{array}$$

$$\begin{array}{rr} 15_{(10)} \Rightarrow & 01111 \\ 19_{(10)} \Rightarrow & 01100 \\ \hline & 11011 \\ & \\ \hline & 1 \end{array}$$

$-$(1's complement of 11011) = $-$00100

$\therefore 15_{(10)} - 19_{(10)}$ using 1's complement = $-$00100

$15_{(10)} - 19_{(10)}$ using 2's complement

1's complement of $19_{(10)}$, 10011 = 01100

$$\begin{array}{r} 01100 \\ + \quad\quad 1 \\ \hline 01101 \end{array}$$

$15_{(10)} \Rightarrow$ 0 1 1 1 1

$19_{(10)} \Rightarrow$ 0 1 1 0 1

$\boxed{X}$ 1 1 1 0 0

$-$(2's complement of 11100) $= -$(1's complement $+1$)

$= -(00011+1) = -0.0100$

5) Subtract $1111.01_{(2)}$ from $1001.101_{(2)}$ using 1's and 2's complement method

$\Rightarrow$ 1's complement of 1111.010 = 0000.101

$$\begin{array}{r} 1001.101 \\ +\ 0000.101 \\ \hline \boxed{X}1010.010 \end{array}$$

$-$(1's complement of 1010.010)

$= -0101.101$

2's complement

1's complement of 1111.010 = 0000.101

$$\begin{array}{r} 1001.101 \\ +\ 0000.101 \\ \hline 1010.010 \end{array}$$

$-$(2's complement of 1010.010)

$= -$(1's complement $+1$)

$= -(0101.101+1)$

$= -\ 0101.101$