Assignment No. 01

23k-3032 (Shah Hussain)

Q1 (a) $(-83)_{10} \rightarrow (\ )_2$

2 | 83
2 | 41 — 1
2 | 20 — 1
2 | 10 — 0
2 | 5 — 0
2 | 2 — 1
1 — 0

(1) 1010011
sign-bit

(b) +101

2 | 101
2 | 50 — 1
2 | 25 — 0
2 | 12 — 1
2 | 6 — 0
2 | 3 — 0
1 — 1

(0) 1100101
sign-bit

(c) -103

2 | 103
2 | 51 — 1
2 | 25 — 1
2 | 12 — 1
2 | 6 — 0
2 | 3 — 0
1 — 1

(1) 1100111
sign-bit

Q2 (a) $(-69)_{10}$ in 1's complement

2 | 69
2 | 34 — 1
2 | 17 — 0
2 | 8 — 1
2 | 4 — 0
2 | 2 — 0
1 — 0

$(69)_2 = 01000101$

$-69 =$ (1) 0111010 (1's complement)
sign-bit

(b) $(+116)_{10}$

2 | 116
2 | 58 — 0
2 | 29 — 0
2 | 14 — 1
2 | 7 — 0
2 | 3 — 1
1 — 1

$(116)_2 = 0\ 1110100$

~~1's complement = 10001011~~

(c) $(-99)_{10}$

2 | 99
2 | 49 — 1
2 | 24 — 1
2 | 12 — 0
2 | 6 — 0
2 | 3 — 0
1 — 1

$(99)_{10} = 0\ 1100011$

1's complement = (1) 0011100
sign-bit

(a) $(-59)_{10}$

2	59	
2	29	1
2	14	1
2	7	0
2	3	1
	1	1

$(59)_2 = 00111011$

1's complement = 11000100

2's complement = 11000100

$+\ 1$

11000101

(b) $(+102)_{10}$

2	102	0
2	51	1
2	25	1
2	12	0
2	6	0
2	3	1
	1	

$(102)_2 = 01100110$

~~1's complement = 10011001~~

~~2's complement = 10011001~~

~~+1~~

~~10011010~~

$(+102)_2 = 01100110$

sign-bit

(c) $(-116)_{10}$

2	116	0
2	58	0
2	29	1
2	14	0
2	7	1
2	3	1
	1	1

$(+116)_{10} = 01110100$

1's complement = 10001011

2's complement = 10001011

$+\ 1$

10001100

Q4 (a) $(10011101)_2 \rightarrow (\ \ )_{10}$

$2^4\ 2^3\ 2^2\ 2^0$

sign-bit

$(-29)_{10}$

(b) $(01110100)_2$

$2^6\ 2^5\ 2^4\ 2^2$

sign-bit

$(+116)_{10}$

(c) $(10111011)_2$

$(-59)_{10}$

Q5

(a) 10111001

$= -2^7 + 2^5 + 2^4 + 2^3 + 2^0$

$= -128 + 32 + 16 + 8 + 1$

$= (-71 + 1) = (-70)_{10}$

(b) 01100100

$= 2^6 + 2^5 + 2^2$

$= 64 + 32 + 4$

$= (100 + 1) = (101)_{10}$

(c) 10111101

$= -2^7 + 2^5 + 2^4 + 2^3 + 2^2 + 2^0$

$= -128 + 32 + 16 + 8 + 4 + 1$

$= (-67 + 1)$

$= (-66)_{10}$

Q6

(a) 10111011

for 2's complement

```
        1000100
      +       1
signbit (1) 1000101
```

$= 2^6 + 2^2 + 2^0$

$= 64 + 4 + 1$

$= (-69)_{10}$

(b) 01010100

2's complement

```
        1  1
 0010101011
        + 1
signbit (0) 0101100
```

$= 2^6 + 2^4 + 2^2$

$= 64 + 16 + 4$

$= (84)_{10}$

(c) 10011000

for 2's complement

```
     1 1 1
 1 1 1 0 0 1 1 1
            + 1
signbit (1) 1101000
```

$= 2^6 + 2^5 + 2^3$

$= 64 + 32 + 8$

$= (-104)_{10}$

(a) -38 and -27

2	38	0
2	19	1
2	9	1
2	4	0
2	2	0
	1	

$(38)_2 = 00100110$

$(-38) = 11011010$

2	27	1
2	13	1
2	6	0
2	3	1
	1	

$(27)_2 = 00011011$

$(-27)_2 = 11100101$

$$\begin{array}{r} 11011010 \\ +\ 11100101 \\ \hline 1\ 10111111 \end{array}$$

$= (10111111)_2$

$= (-65)_{10}$

(b) 59 and -39

2	59	1
2	29	1
2	14	0
2	7	1
2	3	1
	1	

$(59)_2 = 00111011$

2	39	1
2	19	1
2	9	1
2	4	0
2	2	0
	1	

$(39)_2 = 00100111$

$(-39)_2 = 11011001$

$$\begin{array}{r} 00111011 \\ +\ 11011001 \\ \hline 1\ 00010100 \end{array}$$

$= (00010100)_2$

$= (20)_{10}$

-58 and 65

$$\begin{array}{r|l l}
2 & 58 & \\
2 & 29 & 0 \\
2 & 14 & 1 \\
2 & 7 & 0 \\
2 & 3 & 1 \\
 & 1 & 1
\end{array}$$

$(58)_2 = 00111010$

$(-58)_2 = 11000110$

$$\begin{array}{r|l l}
2 & 65 & 1 \\
2 & 32 & 0 \\
2 & 16 & 0 \\
2 & 8 & 0 \\
2 & 4 & 0 \\
2 & 2 & 0 \\
 & 1 &
\end{array}$$

$(65)_2 = 01000001$

$$\begin{array}{r}
11000110 \\
+\ 01000001 \\
\hline
100000111
\end{array}$$

$= (00000111)_2$

$= (7)_{10}$

(d) -102 and -85

$$\begin{array}{r|l l}
2 & 102 & \\
2 & 51 & 0 \\
2 & 25 & 1 \\
2 & 12 & 1 \\
2 & 6 & 0 \\
2 & 3 & 0 \\
 & 1 & 1
\end{array}$$

$(102)_2 = 01100110$

$(-102)_2 = 10011010$

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

$(85)_2 = 01010101$

$(-85)_2 = 10101011$

$$\begin{array}{r}
10011010 \\
+\ 10101011 \\
\hline
101000101
\end{array}$$

invalid, as the result is outside the range of 8-bit representation system

(e) 29 and -72

2	29	
2	14	1
2	7	0
2	3	1
	1	1

$(29)_2 = 00011101$

2	72	
2	36	0
2	18	0
2	9	0
2	4	1
2	2	0
	1	0

$(72)_2 = 01001000$

$(-72)_2 = 10111000$

$$
\begin{array}{r}
00011101 \\
+\ 10111000 \\
\hline
11010101
\end{array}
$$

1

$= (11010101)_2$

$= (-43)_{10}$

Q8

(a) $(4226)_{16} \rightarrow (?)_{10}$

$= (4 \times 16^3) + (2 \times 16^2) + (2 \times 16) + (6 \times 16^0)$

$= 16384 + 512 + 32 + 6$

$= (16934)_{10}$

(b) $(6726)_{16} \rightarrow (?)_{10}$

$= (6 \times 16^3) + (7 \times 16^2) + (2 \times 16) + (6 \times 16^0)$

$= 24576 + 1024 + 32 + 6$

$= (25638)_{10}$

(c) $(2B26)_{16}$

$= (2 \times 16^3) + (11 \times 16^2) + (2 \times 16) + (6 \times 16^0)$

$= 8192 + 2816 + 32 + 6$

$= (11046)_{10}$

(d) $(ABC26)_{16}$

$= (10 \times 16^4) + (11 \times 16^3) + (12 \times 16^2) + (2 \times 16) + (6 \times 16^0)$

$= 655360 + 45056 + 3072 + 32 + 6$

$= (703526)_{10}$

(e) $(6F226)_{16}$

$= (6 \times 16^4) + (15 \times 16^3) + (2 \times 16^2) + (2 \times 16) + (6 \times 16^0)$

$= 393216 + 61440 + 512 + 32 + 6$

$= (455206)_{10}$

1) $(3854)_{10} \rightarrow (?)_{16}$

$$\begin{array}{r|l l} 16 & 3857 & 6 \\ 16 & 228 & 7 \\ & 14 & \end{array}$$

$= (14)76$

$= (E76)_{16}$

b) $(7827)_{10}$

$$\begin{array}{r|l l} 16 & 7827 & 0 \\ 16 & 789 & 9 \\ 16 & 30 & 14 \\ & 1 & \end{array}$$

$= (1E90)_{16}$

(c) $(8926)_{10}$

$$\begin{array}{r|l l} 16 & 8926 & 14 \\ 16 & 557 & 13 \\ 16 & 34 & 2 \\ & 2 & \end{array}$$

$= (22DE)_{16}$

= (d) $(551)_{10}$

$$\begin{array}{r|l l} 16 & 551 & 7 \\ 16 & 37 & 2 \\ & 2 & \end{array}$$

$= (227)_{16}$

(e) $(3682)_{10}$

$$\begin{array}{r|l l} 16 & 3682 & 2 \\ 16 & 230 & 6 \\ & 14 & \end{array}$$

$= (E62)_{16}$

Q10

(a) 11011

Gray code :- 10110

(b) 1001010

Gray code :- 1101111

(c) 111101110111 0

Gray code :- 10001100110 01

Q11

(a) 1010

Binary code :- 1100

(b) 00010

Binary code :- 00011

(c) 11000010001

Binary code :- 10000011110

Q12

(a) 1001 + 0110

$$\begin{array}{r} 1001 \\ +\,0110 \\ \hline 1111 \end{array}$$

(Invalid)

$$\begin{array}{rr} & 1111 \\ & +\,0110 \\ \hline 0001 & 0101 \end{array} \quad (+6)$$

(b) 0011 + 1001.

$$\begin{array}{rr} & 0011 \\ & +\,1001 \\ \hline & 1100 \\ & +\,0110 \\ \hline = 0001 & 0010 \end{array} \quad (+6)$$

) 1001 + 1001

```
   1 0 0 1
 + 1 0 0 1
 ---------
 1 0 0 1 0
 + 0 1 1 0   (+6)
 ---------
 1 1 0 0 0
```

= (00011000)

(f) 01010011 + 01011000

```
    0 1 0 1 0 0 1 1
  + 0 1 0 1 1 0 0 0
  -----------------
    1 0 1 0 1 0 1 1
  + 0 1 1 0 0 1 1 0
  -----------------
  1 0 0 0 1 0 0 0 1
```

= 0001 0001 0001

(d) 1001 + 0111

```
   1 0 0 1
 + 0 1 1 1
 ---------
 1 0 0 0 0
 + 0 1 1 0   (+6)
 ---------
 1 0 1 1 0
```

= (00010110)

(g) 10010101 + 100111000

```
    1 0 0 1 0 1 0 1
  + 1 0 0 1 1 1 0 0 0
  -----------------
    1 1 1 0 0 1 1 0 1
  + 0 1 1 0 0 1 1 0
  -----------------
  1 0 0 0 1 1 0 0 1 1
```

= 0010 0011 0011

(e) 00110101 + 01100111

```
    0 0 1 1 0 1 0 1
  + 0 1 1 0 0 1 1 1
  -----------------
    1 0 0 1 1 1 0 0
  + 0 1 1 0 0 1 1 0
  -----------------
  1 0 0 0 0 0 0 1 0
```

= 0001 0000 0010

(h) 010101101001 + 001100101000

```
    0 1 0 1 0 1 1 0 1 0 0 1
  + 0 0 1 1 0 0 1 0 1 0 0 0
  -------------------------
    1 0 0 0 1 0 0 1 0 0 0 1
                  + 0 1 1 0
  -------------------------
                    0 1 1 1
```

1000 1001 0001

AS