Date _____

Digital Logic & Design

Assignment : 01

23K-2001

BCS-2J

Date _____

Question#1:

Decimal to Binary (sign-magnitude form)

a. $(-83)_{10}$

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

→ 1010011

⇒ $(11010011)_2$ Ans.

sign bit ↵

b. $(+101)_{10}$

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

→ 1100101

⇒ $(01100101)_2$ Ans.

c. $(-103)_{10}$

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

→ 1100111

⇒ $(11100111)_2$ Ans.

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Question #2:

Decimal to Binary (1's complement)

a. $(-69)_{10}$

2	69	
2	34	L1
2	17	L0
2	8	L1
2	4	L0
2	2	L0
	1	L0

→ 01000101

invert

$(10111010)_2$ Ans.

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

2	116	
2	58	L0
2	29	L0
2	14	L1
2	7	L0
2	3	L1
	1	L1

→ $(01110100)_2$ Ans.

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

2	99	
2	49	L1
2	24	L1
2	12	L0
2	6	L0
2	3	L0
	1	L1

→ 01100011

invert

$(10011100)_2$ Ans.

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Question #3:

Decimal to Binary (2's complement)

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

2	59	
2	29	L1
2	14	L1
2	7	L0
2	3	L1
	1	L1

→ 00111011

invert

→ 11000100

+1

⇒ $(11000101)_2$ Ans.

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

2	102	
2	51	L0
2	25	L1
2	12	L1
2	6	L0
2	3	L0
	1	L1

→ 01100110

For positive numbers they are represented in the same way as unsigned numbers

⇒ $(01100110)_2$

Ans.

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

2	116	
2	58	L0
2	29	L0
2	14	L1
2	7	L0
2	3	L1
	1	L1

→ 01110100

invert

10001011

+1

$(10001100)_2$ Ans.

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Question#4:

Binary to Decimal (Sign Magnitude)

a. $(10011101)_2$

$\downarrow \quad \downarrow\downarrow\downarrow \downarrow$

$- \quad 2^4+2^3+2^2+2^0$

$\Rightarrow (-29)_{10}$ Ans.

b. $(01110100)_2$

$\downarrow\downarrow\downarrow\downarrow\downarrow -$

$+ \; 2^6+2^5+2^4+2^2$

$64+32+16+4$

$\Rightarrow (116)_{10}$ Ans.

c. $(10111011)_2$

$- \; 2^5+2^4+2^3+2^1+2^0$

$- (32+16+8+2+1)$

$\Rightarrow (-59)_{10}$ Ans.

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Question # 5:

Decimal Conversion from Binary (1's complement)

a. $(10111001)_2$

1 0 1 1 1 0 0 1

↓ ↓ ↓ ↓ ↓

-128 +32 +16 +8 +1

-71

⟶ Add 1

-71 + 1

$= (-70)_{10}$

Ans.

b. $(01100100)_2$

0 1 1 0 0 1 0 0

↓ ↓ ↓

64 + 32 + 4

$= (100)_{10}$ Ans.

c. $(1\ 0111101)_2$

1 0 1 1 1 1 0 1

↓ ↓ ↓ ↓ ↓ ↓

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

-67

⟶ Add 1

-67 + 1

$= (-66)_{10}$

Ans.

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Question #6:

Binary to Decimal (2's complement)

a. $(10111011)_2$

1 0 1 1 1 0 1 1

↓ ↓ ↓ ↓ ↓ ↓

-128 +32 +16 +8 +2 +1

$\Rightarrow (-69)_{10}$ Ans.

b. $(01010100)_2$

0 1 0 1 0 1 0 0

↓ ↓ ↓

+64 +16 +4

$\Rightarrow (84)_{10}$ Ans.

c. $(10011000)_2$

1 0 0 1 1 0 0 0

↓ ↓ ↓

-128 +16 +8

$\Rightarrow (-104)_{10}$ Ans.

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Question # 7:

Decimal to Binary Addition - 2's complement:

a. -38 & -27

-38

$\Rightarrow 2^5 + 2^2 + 2^1$

$\Rightarrow 38$

00100110

invert

11011001

$+1$

$11011010 \Leftrightarrow (-38)_{10}$

-27

$\Rightarrow 2^4 + 2^3 + 2^1 + 2^0$

$\Rightarrow 27$

00011011

invert

11100100

$+1$

$(11100101)_2 \Leftrightarrow (-27)_{10}$

$$\begin{array}{r} {}^{1}1\ 1\ 0\ 1\ 1\ 0\ 1\ 0 \\ +\ 1\ 1\ 1\ 0\ 0\ 1\ 0\ 1 \\ \hline 1\ 1\ 0\ 1\ 1\ 1\ 1\ 1\ 1 \end{array}$$

$10111111 \Leftrightarrow (-65)_{10}$

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b. 59 and -39

$(-39)_{10}$

$\Rightarrow 2^5 + 2^2 + 2^1 + 2^0$

00100111

invert

11011000

+1

11011001 $\Leftrightarrow (-39)_{10}$

$(59)_{10}$

$\Rightarrow$

$2^5 + 2^4 + 2^3 + 2^1 + 2^0$

00111011

$\rightarrow$ 00111011

+11011001

10010100

$(00010100)_2 \Leftrightarrow (20)_{10}$

Ans.

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c. -58 and 65:

$(-58)_{10}$

$\Rightarrow 2^5 + 2^4 + 2^3 + 2^1$

00111010

invert

11000101

+1

11000110 $\Leftrightarrow (-58)_{10}$

$(65)_{10}$

$\Rightarrow 2^6 + 2^0$

01000001

$\rightarrow$ 01000001

+11000110

10000111

$(00000111)_2 \Leftrightarrow (7)_{10}$

Ans.

d. -102 and -85

$(-102)_{10}$

$\Rightarrow 2^6 + 2^5 + 2^2 + 2^1$

01100110

invert

10011001

+1

10011010

$(-85)_{10}$

$\Rightarrow 2^6 + 2^4 + 2^2 + 2^0$

01010101

invert

10101010

+1

10101011

10011010 + 10101011 = 101000101

Overflow occured

$(01000101)_2$

Solution not valid due to overflow!

Ans. $\Leftrightarrow$

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e. 29 and -72

$(-72)_{10}$

$\Rightarrow 2^6 + 2^3$

01001000

invert

10110111

+1

10111000

$(29)_{10}$

$\Rightarrow 2^4 + 2^3 + 2^2 + 2^0$

00011101

$\rightarrow$ 0'00'11101

+ 10111000

$(1101.0101)_2 \Leftrightarrow (-43)_{10}$

Ans.

Question#8:

Hexadecimal to Decimal

a. $(4226)_{16}$

4 2 2 6

$(4\times16^3) + (2\times16^2) + (2\times16^1) + (6\times16^0)$

$\Rightarrow 16384 + 512 + 32 + 6$

$\Rightarrow (16934)_{10}$

Ans.

b. $(6426)_{16}$

6 4 2 6

$(6\times16^3) + (4\times16^2) + (2\times16^1) + (6\times16^0)$

$\Rightarrow 24576 + 1024 + 32 + 6$

$\Rightarrow (25638)_{10}$

Ans.

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

2 B 2 6

↓ ↓ ↓ ↓

2 11 2 6

$(2\times16^3) + (11\times16^2) + (2\times16^1) + (6\times16^0)$

$\Rightarrow 8192 + 2816 + 32 + 6$

$\Rightarrow (11046)_{10}$

Ans.

d. $(ABC26)_{16}$

A B C 2 6

↓ ↓ ↓ ↓ ↓

10 11 12 2 6

$(10\times16^4) + (11\times16^3) + (12\times16^2) + (2\times16^1) + (6\times16^0)$

$\Rightarrow 655360 + 45056 + 3072 + 32 + 6$

$\Rightarrow (703526)_{10}$

Ans.

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

6 F 2 2 6

↓ ↓ ↓ ↓ ↓

6 15 2 2 6

$(6\times16^4) + (15\times16^3) + (2\times16^2) + (2\times16^1) + (6\times16^0)$

$\Rightarrow 393216 + 61440 + 512 + 32 + 6$

$\Rightarrow (455206)_{10}$

Ans.

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Question#9:

Decimal to Hexadecimal

a. $(3654)_{10}$

16	3654	
16	228	6
	14	4

→ 14 4 6

$(E46)_{16}$ Ans.

b. $(7824)_{10}$

16	7824	
16	489	0
16	30	9
	1	14

→ 1 14 9 0

$(1E90)_{16}$ Ans.

c. $(8926)_{10}$

16	8926	
16	557	14
16	34	13
	2	2

→ 2. 2 13 14

$(22DE)_{16}$ Ans.

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d. $(551)_{10}$

16	551
16	34 L7 ↑
	2 L2

→ $(227)_{16}$ Ans.

e. $(3682)_{10}$

16	3682
16	230 L2 ↑
	14 L6

→ 14 6 2

$(E62)_{16}$ Ans.

Question #10

Binary to Gray Code

a. $(11011)_2$

1 1 0 1 1

↓ → ↓ → ↓ → ↓ → ↓

1 0 1 1 0

Gray code: $(10110)_2$ Ans.

b. $(1001010)_2$

1 0 0 1 0 1 0

↓ → ↓ → ↓ → ↓ → ↓ → ↓ → ↓

1 1 0 1 1 1 1

Gray code: $(1101111)_2$ Ans.

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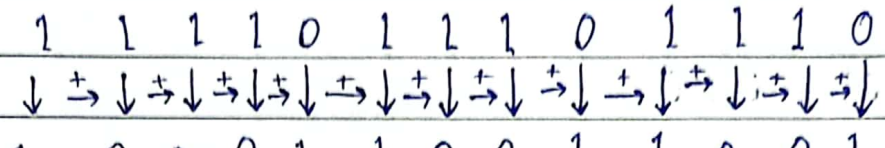
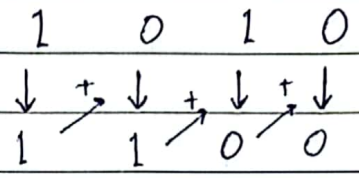
c. $(1111011101110)_2$



Gray code: $(1000110011001)_2$ Ans.

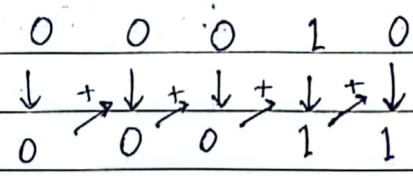
Question # 11:
Gray code to Binary

a. 1010



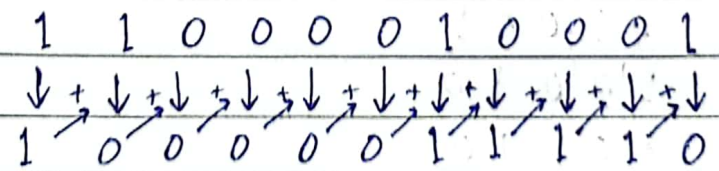
Bin: $(1100)_2$ Ans.

b. 00010



Bin: $(00011)_2$ Ans.

c. 11000010001



Bin: $(10000011110)_2$ Ans.

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Question # 12:

BCD Addition

a. 1001 + 0110

```
  1 0 0 1
+ 0 1 1 0
  1 1 1 1
+ 0 1 1 0
0001 0 1 0 1      Ans: (0001 0101)2
 ↓   ↓              (15)10
 1   5
```

b. 0011 + 1001

```
    1 1
  0 0 1 1
+ 1 0 0 1
  1 1 0 0
+ 0 1 1 0
0001 0 0 1 0      Ans. (0001 0010)2
 ↓   ↓              (12)10
 1   2
```

c. 1001 + 1001

```
    1
  1 0 0 1
+ 1 0 0 1
  1 0 0 1 0
+ 0 1 1 0
0001 1 0 0 0      Ans. (0001 1000)2
 ↓   ↓              (18)10
 1   8
```

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d. 1001 + 0111

```
  1001
+ 0111
------
 10000
+ 0110
------
0001 0110
```

Ans: $(0001\ 0110)_2$

$(16)_{10}$

e. 00110101 + 01100111

```
  0011  0101
+ 0110  0111
-----------
 1001  1100
+ 0110
-----------
 1010  0010
+ 0110
-----------
0001 0000 0010
```

16-bit representation

Ans: $(0000\ 0001\ 0000\ 0010)_2$

$(102)_{10}$

f. 01010011 + 01011000

```
  0101  0011
+ 0101  1000
-----------
 1010  1011
+ 0110  0110
-----------
0001 0001 0001
```

Ans: $(0000\ 0001\ 0001\ 0001)_2$

$(111)_{10}$

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g. 10010101 + 100111000

```
    1 1
  1001  0101
+ 1 0011  1000
-------------
  1 1110  1101
+   0110  0110
-------------
  0010  0011  0011
    ↓     ↓     ↓
    2     3     3
```

Ans: $(0000\ 0010\ 0011\ 0011)_2$

$(233)_{10}$

h. 010101101001 + 001100101000

```
  0101  0110  1001
+ 0011  0010  1000
-----------------
  1000  1001  0001
            + 0110
-----------------
  1000  1001  0111
    ↓     ↓     ↓
    8     9     7
```

Ans. $(0000\ 1000\ 1001\ 0111)_2$

16-bit representation $(897)_{10}$