COE 202, Term 052

Fundamentals of Computer Engineering

HW# 1

Q.1. Convert the following numbers from the given base to the bases indicated:

- **(i)** Decimal 225.225 to binary, octal, and hexadecimal.
- **(ii)** Binary 11010111.110 to decimal, octal, and hexadecimal.
- **(iii)** Octal 623.77 to decimal, binary and hexadecimal.
- **(iv)** Hexadecimal 2AC5.D to decimal, octal and binary.

Q.2. Perform the following arithmetic operations using the designated bases without converting to decimal. Verify your result by converting the numbers to decimal and then performing the operation in decimal:

- **(i)** $(10E)_{16} + (13F)_{16}$
- **(ii)** $(1E)_{16} * (10)_{16}$
- **(iii)** $(1101)_2 * (1000)_2$

Q.3. Obtain the 1`s and 2`s complement of the following binary numbers: 01100, 00001,00000

Q.4. Find the 10`s complement of $(935)_{11}$.

Q.5. Show how the decimal integer -120 would be represented in 2`s complement notation using 8 bits and 16 bits, respectively.

Q.6. Perform subtraction with the following binary numbers using 2`s complement and 1`s complement, assuming that numbers are represented in 6 bits. Check the answer by straight subtraction:

- **(i)** 11010 - 1101
- **(ii)** 11010 - 10000
- **(iii)** 10010 - 10011

Q.7. A microcontroller uses 8-bit registers. Give the following in both binary and decimal:

- **(i)** The maximum unsigned number that can be stored.

(ii) The smallest (negative) number and the largest (positive) number that can be stored using the sign-magnitude notation.

(iii) The smallest (negative) number and the largest (positive) number that can be stored using the 2`s complement notation.

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HW#1

Q1 (i) 225.225

Binary 1110 0001 . 0011 1001 1001

Octal 341 . 163--

Hexadecimal E1 . 399--

(ii) Binary 11010111.110

Decimal 215 .75

Octal 327.6

Hexadecimal D7 . C

(iii) Octal 623.77

Decimal 403 . 98437--

Binary 110 010 011. 111 111

(iv) Hexadecimal 2AC5. D

Decimal 10949. 8125

Binary 0010 1010 1100 0101 . 1101

Octal 25305 . 64

Q2

(i)

$$\begin{array}{r} {}^{1} \\ 10E \\ +\ 13F \\ \hline 24D \end{array} \qquad \begin{array}{r} 270 \\ +\ 319 \\ \hline 589 \end{array}$$

(ii)

$$\begin{array}{r} 1E \\ *\ 10 \\ \hline 00 \\ 1E \\ \hline 1E0 \end{array} \qquad \begin{array}{r} 30 \\ *\ 16 \\ \hline 180 \\ 30 \\ \hline 480 \end{array}$$

(iii)

$$\begin{array}{r} 1101 \\ *\ 1000 \\ \hline 0000 \\ 0000 \\ 0000 \\ 1101 \\ \hline 1101000 \end{array} \qquad \begin{array}{r} {}^{2}13 \\ \times\ 8 \\ \hline 104 \end{array}$$

Q3

Number	1's Complement	2's Complement
01100	10011	10100
00001	11110	11111
00000	11111	00000

Q4 10's complement of $(935)_{11}$ = 175

$$\begin{array}{r} 10\ \ 10\ \ 10 \\ -\ \ 9\ \ \ \ 3\ \ \ \ 5 \\ \hline 1\ \ \ \ 7\ \ \ \ 5 \end{array}$$

Q5 −120

we represent +120 using 8-bits

7	6	5	4	3	2	1	0
0	1	1	1	1	0	0	0

2's complement is 1 0 0 0 1 0 0 0

−120 represented in 16 bits will be just a sign extension of 8-bit representation

1111 1111 1000 1000

Q6

(i) 11010 − 1101

1's complement

```
   1   1
   01 1010
 + 110010
 ---------
(1)← 001100
 +        1  ← we add the carry out
 ---------
   001101
```

straight subtraction

```
      2
    0 0 2 0 2
  0 1 1 0 1 0
−     1 1 0 1
  -----------
    0 0 1 1 0 1
```

2's complement

```
   1     1
   0 11010
 + 1 10011
 ---------
(1)← 001101
```

(ii) 11010 − 10000

1's complement

```
   1 1 1  1
   0 1 1 0 1 0
 + 1 0 1 1 1 1
 -------------
(1)← 0 0 1 0 0 1
               1  ← we add the
 + -----------      carry out
   0 0 1 0 1 0
```

straight subtraction

```
   0 1 1 0 1 0
 − 0 1 0 0 0 0
 -------------
   0 0 1 0 1 0
```

2's complement

```
    1
    0 1 1 0 1 0
 + 1 1 0 0 0 0
 -------------
(1)← 0 0 1 0 1 0
```

(iii) 10010 − 10011

1's complement

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

This represents −1

straight subtraction

```
 1  2    1 1  2 2
 0  0  1 0 0  1 0
 − 0 1 0 0 1 1
 -------------
   1 1 1 1 1 1
```

Note here that there is a borrow

2's complement

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

This represents −1

Q7 8-bit register

(i) maximum unsigned number

$2^8 - 1 = 255$ 1111 1111

(ii) sign-magnitude

smallest negative number

$-(2^7 - 1) = -127$ 1111 1111

largest positive number

$2^7 - 1 = +127$ 0111 1111

(iii) 2's complement

smallest negative number

$-2^{8-1} = -2^7 = -128$ 1000 0000

largest positive number

$+2^7 - 1 = 127$ 0111 1111