EE 109 Homework 2

Name: ____SOLUTIONS________________________
Due: ______________________ Score: ________
Show work to get full credit. Remember, use on only one side of the paper and staple them together. Only use a calculator to CHECK your work, not to DO your work.

1.) Perform the following number system conversions. Note: It may be easier to convert them to the desired base in a different order than shown here. (18 pts.)

a. 1100101.1011\_2 = ?\_8 = ?\_16 = ?\_10
b. 1A9.D\_16 = ?\_8 = ?\_2 = ?\_10
c. 617\_8 = ?\_16 = ?\_2 = ?\_10

1.a \hspace{1cm} 1100101.1011\_2 = 1*2^6 + 1*2^5 + 1*2^2 + 1*2^0 + 1*2^{-1} + 1*2^{-4} = 101.6875\_10
\hspace{1cm} = 001 | 100 | 101.101 | 100\_2 = 145.54\_8
\hspace{1cm} = 0110 | 0101 | 10111 | 100\_2 = 65.B\_16

1.b \hspace{1cm} 1A9.D\_16 = 1*16^2 + 10*16^1 + 9*16^0 + 13*16^{-1} = 425.8125\_10
\hspace{1cm} = 11010 | 1001.110 | 100\_2 = 651.64\_8

1.c \hspace{1cm} 617\_8 = 6*8^2 + 1*8^1 + 7*8^0 = 399\_10
\hspace{1cm} = 110 | 001 | 111\_2
\hspace{1cm} = 0001 | 1000 | 1111\_2 = 18F\_16
2.) What are the corresponding decimal representations for the following binary strings: 
10110110, 11011011, if

a. The binary numbers are using *8-bit unsigned* format?
   
   \[
   10110110 = 128 + 32 + 16 + 4 + 2 = 182 \\
   11011011 = 128 + 64 + 16 + 8 + 2 + 1 = 219
   \]

b. The binary numbers are using *8-bit 2's complement* format?
   
   \[
   10110110 = -128 + 32 + 16 + 4 + 2 = -74 \\
   11011011 = -128 + 64 + 16 + 8 + 2 + 1 = -37
   \]

3.) For each of the following decimal numbers find the corresponding 8-bit representation using
   the indicated systems. Note: Some numbers may NOT be representable w/ 8-bits. Also find
   the minimum bits needed to represent the number in the 2’s complement system.

<table>
<thead>
<tr>
<th>2’s Complement</th>
<th>Minimum bits needed using 2’s complement</th>
</tr>
</thead>
<tbody>
<tr>
<td>-128</td>
<td>00000000</td>
</tr>
<tr>
<td>+31</td>
<td>00011111</td>
</tr>
<tr>
<td>+59</td>
<td>00111011</td>
</tr>
<tr>
<td>-16</td>
<td>11110100</td>
</tr>
</tbody>
</table>

4.) Each C declaration of the variable \(x\) is initialized to a value in decimal. Show that value
   represented in hex using the appropriate size indicated by the variable type
   (e.g. char = 1-byte = 2 hex digits). Do not use a calculator.

   a. short int \(x\) = 13; \quad 0x000D
   b. short int \(x\) = -32,767; \quad 0x8001
   c. unsigned char = 246; \quad 0xF6
   d. int \(x\) = -4096; \quad 0xFFFFFFFF000
   e. unsigned char \(x\) = 193; \quad 0xC1
   f. int \(x\) = -1; \quad 0xFFFFFFFF
   g. unsigned char \(x\) = ‘a’; \quad 0x61
   h. short int \(x\) = 40; \quad 0x0028
   i. unsigned char \(x\) = 97; \quad 0x61
   j. char \(x\) = -79; \quad 0xB1
5.) Convert the powers of 2 shown below to its approximate decimal value using K to represent $10^3$, M for $10^6$, G for $10^9$, and T for $10^{12}$. (e.g. $2^{12} \approx 4K$)

a.) $2^{19} = \underline{512} \text{ K}$$

b.) $2^{36} = \underline{64} \text{ G}$$

c.) $2^{43} = \underline{8} \text{ T}$$

d.) $2^{24} = \underline{16} \text{ M}$$