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Group #:

## ECE 120 Worksheet 2: Binary Representation and Arithmetic

- 1) Perform the following 8-bit binary arithmetic additions. Perform the operation twice: (1st) assume that the numbers are represented with unsigned binary representation and (2nd) assume that the numbers are represented with 2's complement binary representation. Convert the operations to decimal to check your work.

Indicate when and why overflow occurs and discuss what you would need to do if you cannot represent the correct answer with the 8 bits or unsigned binary representation.

### Unsigned binary representation:

a) 10100100 <b>164</b>	b) 00111011 <b>59</b>	c) 10110111 <b>183</b>
+ 01001110 <b>78</b>	+ 01011010 <b>90</b>	+ 11011011 <b>219</b>
<u>          </u>	<u>          </u>	<u>          </u>
<b>11110010    242</b>	<b>10010101    149</b>	<b>110010010    402</b>
<b>no overflow</b>	<b>no overflow</b>	<b>overflow as indicated by the carry out bit.</b>

### 2's complement binary representation:

a) 10100100 <b>-92</b>	b) 00111011 <b>59</b>	c) 10110111 <b>-73</b>
+ 01001110 <b>+78</b>	+ 01011010 <b>90</b>	+ 11011011 <b>-37</b>
<u>          </u>	<u>          </u>	<u>          </u>
<b>11110010    -14</b>	<b>10010101    -107</b>	<b>110010010    -110</b>
<b>no overflow</b>	<b>overflow</b>	<b>no overflow,</b>
	<b>("+" + "+" = "-")</b>	<b>carry out bit is ignored</b>

- 2) Order the numbers below, first interpreting the bit patterns using the unsigned representation, then using the 2's complement representation.

$(01110100)_2$ ,  $(11101101)_2$ ,  $(00110100)_2$

Unsigned:  $11101101_2 > 01110100_2 > 00110100_2$

2's complement:  $01110100_2 > 00110100_2 > 11101101_2$