

ECE 370: Digital Systems-Logic Design

Sample Test: Chapter 5-Part 2

Spring 2005

Signed Number Representations, Complements, and Overflow

1. Fill in the following table by converting the decimal numbers into 6-bit sign-magnitude, one's complement, and two's complement forms. Is there any that you cannot represent? What are the largest positive and negative numbers that can be represented using each scheme?

Number ₁₀	6-bit Sign Magnitude	6-bit One's Comp	6-bit Two's Comp
15			
-10			
-75			
-12			
50			
-30			
20			
7			

2. Describe a general method to perform an r 's complement on a number of any *radix*, r ? For example, if $r = 2$, then there is a 2's complement. Try to provide an "equation" of some sort that describes the operation.
3. Describe a general method to perform a $(r - 1)$ complement on a number of any *radix*, r ? For example, if $r = 2$, then there is a $(2 - 1)$'s complement, or 1's complement. Like the above problem, try to provide an "equation" of some sort that describes the operation.
4. Fill in the following table by finding the 10-digit r 's complement and $(r - 1)$'s complement of the following numbers.

Number	10 digit $(r - 1)$'s Complement	10 digit r 's Complement
256 ₁₀		
436 ₇		
210 ₁₆		
312 ₃		
83 ₉		
110 ₈		

5. Perform the following arithmetic operations using the $(r-1)$ complement and r complement schemes. Do any of the results not make sense? Why or why not?
- a) $455_{10} + 250_{10}$
 - b) $200_{10} - 310_{10}$
 - c) $1111000001_2 - 1011111010_2$
 - d) $ACF_{16} - B9A_{16}$
 - e) $11110001_2 - 00111001_2$
 - f) $10011_2 - 11111_2$
6. What is overflow, and when does it occur for 1's complement and 2's complement numbers? Does overflow only occur with signed binary numbers?
7. Intuitively, can you come up with a way to detect overflow? (Hint: Use simple decimal arithmetic examples to help you come up with the solution).