Solutions - Quiz 2

(February 6th @ 5:30 pm)

PROBLEM 1 (40 PTS)

- Complete the following table. Use the <u>fewest</u> number of bits in each case:

REPRESENTATION			
Decimal	**Sign-and-magnitude**	**1's complement**	**2's complement**
−2	110	101	10
6	0110	0110	0110
−5	1101	1010	1011
−4	1100	1011	100

- Convert the following decimal number to its 2's complement representation: −12.75 (5 pts)
  $12.75 = 01100.11_2 \rightarrow -12.75 = 10011.01_2$

PROBLEM 2 (20 PTS)

- Perform the following operation in the 2's complement representation, i.e., provide the summands and the result in 2's complement representation. Use the minimum number of bits to represent both the summands and the result so that the overflow bit is 0.
  ✓ −12 − 27

  n = 6 bits
  $c_6 \oplus c_5 = 1$
  Overflow!

  $c_6=1 \; c_5=0 \; c_4=0 \; c_3=1 \; c_2=0 \; c_1=0 \; c_0=0$

  -27 = 1 0 0 1 0 1 +
  -12 = 1 1 0 1 0 0
  _____
  -39 = 0 1 1 0 0 1

  $-27 -12 = -39 \notin [-2^5, 2^5-1] \rightarrow$ overflow!

  To avoid overflow:
  n = 7 bits (sign-extension)
  $c_7 \oplus c_6 = 0$
  No Overflow

  $c_7=1 \; c_6=1 \; c_5=0 \; c_4=0 \; c_3=1 \; c_2=0 \; c_1=0 \; c_0=0$

  -27 = 1 1 0 0 1 0 1 +
  -12 = 1 1 1 0 1 0 0
  _____
  -39 = 1 0 1 1 0 0 1

  $-27 -12 = -39 \in [-2^6, 2^6-1] \rightarrow$ no overflow

PROBLEM 3 (40 PTS)

- Complete the timing diagram of the circuit shown below:

z=0 when P=0000