## Solutions - Quiz 2

(October 11<sup>th</sup> @ 5:30 pm)

## PROBLEM 1 (40 PTS)

• Complete the following table:

REPRESENTATION			
Decimal	Sign-and-magnitude	1's complement	2's complement
5	0101	0101	0101
-8	11000	10111	1000
-4	1100	1011	100
-9	11001	10110	10111

• Convert the following decimal number to its 2's complement representation: -9.25 (5 pts) +9.25 = 01001.01<sub>2</sub>  $\rightarrow -9.25$  = 10110.11<sub>2</sub>

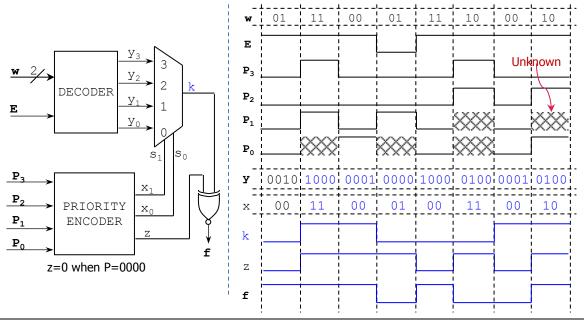
## PROBLEM 2 (20 PTS)

Perform the following operations in the 2's complement system, i.e., provide the summands and the result in 2's complement representation (<u>indicate the carries</u>). Use the minimum number of bits to represent both the summands and the result so that the overflow bit is 0.

n = 5 bits ✓ -15 - 9 c₅⊕c₄=1  $c_{4}=C$  $c_{3}=1$  $c_{2}=1$  $c_{1}=1$  $c_{0}=0$ Overflow!  $-15 = 1 \ 0 \ 0 \ 1 \ +$ -9 = 10111-24 = 0 1 0 0 0 $-15 -9 = -24 \notin [-2^4, 2^4 - 1] \rightarrow \text{overflow!}$ To avoid overflow: n = 6 bits (sign-extension) c<sub>7</sub>⊕c<sub>6</sub>=0  $c_6=1$  $c_5=1$  $c_4=0$  $c_3=1$  $c_3=1$  $c_2=1$  $c_1=1$  $c_1=0$ No Overflow -15 = 1 1 0 0 0 1 + - 9 = 1 1 0 1 1 1  $-24 = 1 \ 0 \ 1 \ 0 \ 0$  $-15 - 9 = -24 \in [-2^5, 2^5-1] \rightarrow \text{no overflow}$ 

## PROBLEM 3 (40 PTS)

• Complete the timing diagram of the circuit shown below:  $y = y_3 y_2 y_1 y_0$ ,  $x = x_1 x_0$ 



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