Name: **Id#**

COE 202, Term 151
Digital Logic Design

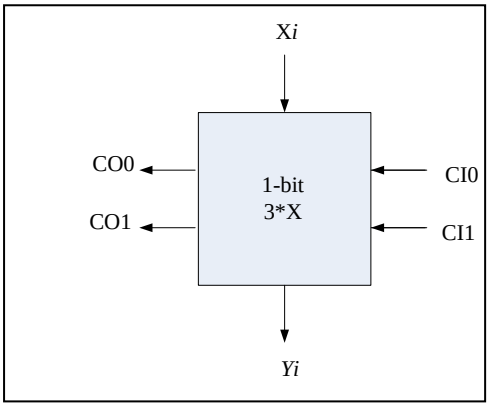
Quiz# 4

Date: Tuesday, Nov. 3

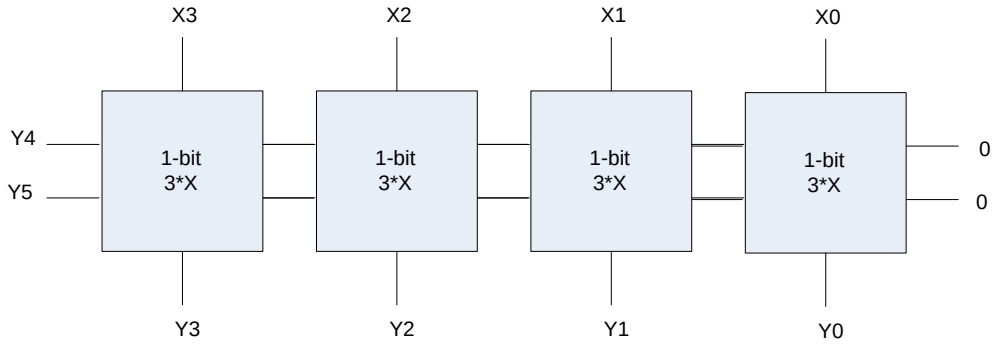
Q1. It is required to design a Tripler circuit. The circuit receives an n-bit number X and computes the result Y=3*X.

a. If the input is an *n*-bit unsigned number, what is the size of the output "*y*" in bits?

b. The circuit can be constructed using *n identical copies* of the basic 1-bit cell shown to the right. The cell processes one input bit (X*i*) and produces one output bit (Y*i*) and two output carry bits (CO0 and CO1). To allow for cascading *n* such cells to implement an *n*-bit Tripler, the basic cell also accepts two input carry bits (CI0 and CI1). When the output carry equals 1 then CO1 CO0 = 01, while when it equals 2 then CO1 CO0 = 10.



The Figure below shows how a 4-bit Tripler circuit is implemented using 4 copies of the basic 1-bit cell.



Derive the truth table for the basic one-bit cell.
(Hint: *As the initial input carries = 00, the maximum carry from one cell to the next is 2*)

c. Derive a minimized sum-of-product expressions for the outputs of the basic one-bit cell.

Q2.

a. Fill in all blank cells in the two tables below. <u>All binary representations use 7 bits</u>

Binary	Equivalent decimal value with the binary interpreted as:			
	Unsigned number	Signed-magnitude number	Signed-1's complement number	Signed-2's complement number
1011010				

Decimal	Binary representation in:		
	Signed-magnitude notation	Signed-1's complement notation	Signed-2's complement notation
- 59			

b. Using 2's-complement signed arithmetic in **5 bits**, perform the following operations in binary. Show all your work. Verify that you get the expected decimal results.

<u>Check for overflow and mark clearly any occurrences of it</u>.

(i) 11010 + 11001	(ii) 00101 - 10100
(iii) (+5) + (-9)	(iv) (-6) - (+8)

c. When doing signed 2's complement arithmetic in **<u>6 bit</u>**s, the ***<u>smallest</u>*** binary number **that will cause overflow** when ***<u>subtracted</u>*** from $101000)_2$ is _____.