Name: _____ ID# _____

Date Submitted: _____ Lab Section # _____

CSE 2441 – Digital Logic Design Fall Semester 2020

**Lab Number 3 – Basic Adders**

Due September 20, 2020 (11:59 PM)

This exercise uses The BitBoard.

**CSE 2441** **LABORATORY SESSION 3** **FALL 2020**

# BASIC ADDERS

# (100 POINTS)

## PURPOSE/OUTCOMES

To introduce you to basic circuits for adding binary numbers. After completing this lab, you will have demonstrated an ability to design four-bit adders, to capture and verify your designs using Quartus II, and to construct and test your designs on a BB/DE1.

## LAB REQUIREMENTS

In Lab 2, you designed and simulated a full adder and a four-bit ripple-carry adder that used four full-adders as components as shown in Figure 1. In this lab you will construct and test these circuits.

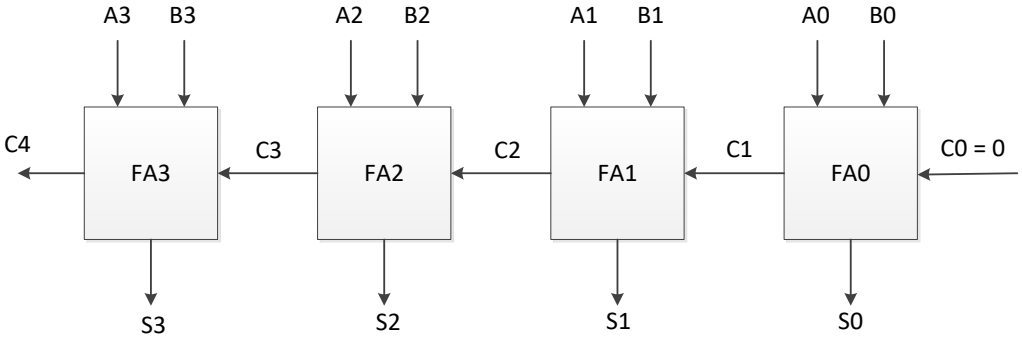


**Figure 1 – Four-Bit Ripple-Carry Adder (A + B)**

1. Prove that both of the following circuits realize a full adder by constructing them on the BitBoard and experimentally deriving their truth tables. **Take pictures of your circuits and record your truth tables for your lab report.** Use the following BB/DE1 pin assignments when deriving the truth tables.

   ***A***: SW2, ***B***: SW1, ***C***: SW0, ***S*** (circuit 1): LEDR1, ***Cout*** (circuit 1): LEDR0,
   ***S*** (circuit 2): LEDG1, ***Cout*** (circuit 2): LEDG0

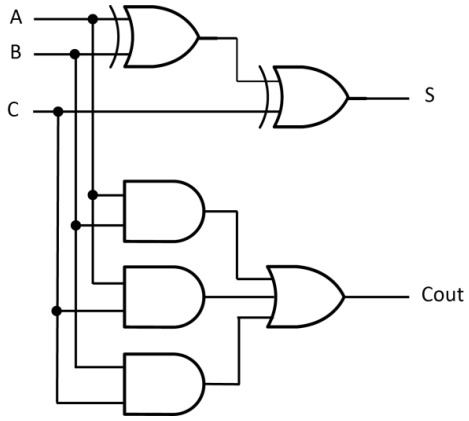


**Figure 2 – Circuit 1**

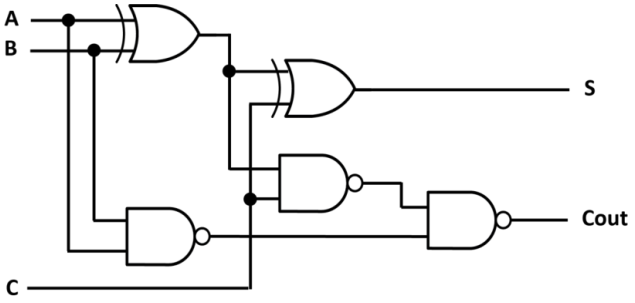


**Figure 3 – Circuit 2**

2. Using the simplest(fewest chips) full adder circuit from above, construct a four-bit ripple-carry adder realization as shown in Figure 1. **Note: It is wise to build and test your adder one stage at a time!** Use the following BB/DE1 pin assignments.

   *A3:* SW7, *A2:* SW6, *A1*: SW5, *A0*: SW4
   *B3*: SW3, *B2*: SW2, *B1*: SW1, *B0*: SW0
   *S3*: LEDR3, *S2*: LEDR2, *S1*: LEDR1, *S0*: LEDR0
   *C4*: LEDR4
   *C0*: SW8

   **Take a picture of your completed circuit.**

3. Test your ripple-carry adder for the values of *A* and *B* in the following table.

| ***A*** | ***B*** | ***S = A + B*** | ***Cout (C4)*** |
|---|---|---|---|
| 0101 | 0001 | | |
| 0111 | 0001 | | |
| 0111 | 1111 | | |
| 1001 | 1110 | | |
| 1010 | 1110 | | |
| 1101 | 1100 | | |

4. If *A*3, *B*3, and *C*3 are sign bits, do any of the above results produce an overflow?

**REPORT REQUIREMENTS**

1. Cover sheet (as shown on this assignment)
2. Lab purpose
3. Picture of Circuit 1
4. Truth table of Circuit 1
5. Picture of Circuit 2
6. Truth table of Circuit 2
7. Picture of Ripple-Carry Adder Circuit
8. Ripple-carry adder test results table
9. Answers to #4.

## LEAVE YOUR RIPPLE-CARRY ADDER CIRCUIT ON THE BITBOARD FOR USE IN LAB #4.