

Name and Std ID: DmHull 053855830 Lab Section: 1

Date: 03/22/22

PRELAB:

Q1. Before you fill in the answers to this prelab make sure that you understand binary arithmetic, especially signed number representation (2's Complement) and overflow in arithmetic addition and subtraction. Do the following arithmetic operations and write down the expected sum, carry and overflow:

In case of subtraction, since we are doing a 2's Complement addition Cout is the carryout of the adder.

| Binary numbers to add/subtract | Sum | Cout | Overflow |
|--------------------------------|------|------|----------|
| 1011 - 0110 | 0101 | 1 | 1 |
| 1001 - 0010 | 0111 | 1 | 1 |
| 0001 + 0111 | 1000 | 1 | 1 |
| 1100 + 0110 | 0010 | 0 | 0 |
| 0011 - 1101 | 0110 | 0 | 0 |
| 0101 + 1011 | 0000 | 0 | 0 |

$$\begin{array}{r} \boxed{1}010 \\ \times \quad 1011 \\ \hline + \quad 1010 \\ \hline 0101 \end{array}$$

$$\begin{array}{r} \boxed{1}000 \\ \times \quad 1110 \\ \hline + \quad 1110 \\ \hline 0111 \end{array}$$

$$\begin{array}{r} \boxed{1}000 \\ \times \quad 0111 \\ \hline + \quad 0111 \\ \hline 1000 \end{array}$$

$$\begin{array}{r} \boxed{1}100 \\ \times \quad 0110 \\ \hline + \quad 0110 \\ \hline 0010 \end{array}$$

$$\begin{array}{r} \boxed{0}011 \\ \times \quad 0101 \\ \hline + \quad 0011 \\ \hline 0110 \end{array}$$

$$\begin{array}{r} \boxed{1}111 \\ \times \quad 0101 \\ \hline + \quad 1011 \\ \hline 0000 \end{array}$$

Q2. Complete the truth table for a full adder:

| X | Y | Cin | Cout | S |
|---|---|-----|------|---|
| 0 | 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 0 | 1 |
| 0 | 1 | 0 | 0 | 1 |
| 0 | 1 | 1 | 1 | 0 |
| 1 | 0 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 | 0 |
| 1 | 1 | 0 | 1 | 0 |
| 1 | 1 | 1 | 1 | 1 |

Q3. Complete the assignment expressions for S and Cout below:

```
module FA (Cin, X, Y, S, Cout);
    input Cin, X, Y;
    output Cout, S;
    assign S = (expression for S);
    assign Cout = (expression for Cout);
```

Expression for S: $(\bar{X} \cdot \bar{Y} \cdot \text{Cin}) + (\bar{X} \cdot Y \cdot \bar{\text{Cin}}) + (X \cdot \bar{Y} \cdot \bar{\text{Cin}}) + (X \cdot Y \cdot \text{Cin})$

Expression for Cout: $(\bar{X} \cdot Y \cdot \text{Cin}) + (X \cdot \bar{Y} \cdot \text{Cin}) + (X \cdot Y \cdot \bar{\text{Cin}}) + (X \cdot Y \cdot \text{Cin})$

TA Initials: _____

LAB:

ModelSim demonstrates a good circuit. TA Initials: _____