

## Lab #2 (Boolean Arithmetic)

Name: \_\_\_\_\_

Date: \_\_\_\_\_

1. Given the following Truth Table	a) Write the function in its canonical form																																				
<table border="1"> <thead> <tr> <th>A</th> <th>B</th> <th>C</th> <th>F</th> </tr> </thead> <tbody> <tr><td>0</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>0</td><td>1</td><td>1</td></tr> <tr><td>0</td><td>1</td><td>0</td><td>0</td></tr> <tr><td>0</td><td>1</td><td>1</td><td>1</td></tr> <tr><td>1</td><td>0</td><td>0</td><td>0</td></tr> <tr><td>1</td><td>0</td><td>1</td><td>1</td></tr> <tr><td>1</td><td>1</td><td>0</td><td>1</td></tr> <tr><td>1</td><td>1</td><td>1</td><td>1</td></tr> </tbody> </table>	A	B	C	F	0	0	0	0	0	0	1	1	0	1	0	0	0	1	1	1	1	0	0	0	1	0	1	1	1	1	0	1	1	1	1	1	$f = \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C} + AB\bar{C} + ABC$
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2. Given the following Truth Table					a) Write the function in its canonical form																																																																																								
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**Converting between Binary and Decimal Numbers**

4. Convert **1110001**<sub>2</sub> to decimal (base 10)  
Use sum of expansion of products (don't skip steps!)

$$\begin{array}{ccccccc} 1 & 1 & 1 & 0 & 0 & 0 & 1 \\ \hline 64 & 32 & 16 & 8 & 4 & 2 & 1 \end{array} = 113$$

5. Convert **11011100**<sub>2</sub> to decimal (base 10)  
Use sum of expansion of products (don't skip steps!)

$$\begin{array}{ccccccc} 1 & 1 & 0 & 1 & 1 & 1 & 0 & 0 \\ \hline 128 & 64 & 32 & 16 & 8 & 4 & 2 & 1 \end{array} = 220$$

**Converting between Decimal and Binary Numbers**

6. Convert **35**<sub>10</sub> to binary (base 2)  
Use the Double-Dabble method of successive division (don't skip steps!)

$$\begin{array}{ccccccc} & 1 & & 1 & & 0 & 0 & 0 & 1 \\ 35 & -2 & = & 17 & \div 2 & = & 8 & \div 2 & = & 4 & \div 2 & = & 2 & \div 2 & = & 1 & \div 2 & = & 0 \end{array}$$

$$35 = 100011$$

7. Convert **111**<sub>10</sub> to binary (base 2)

Use the Double-Dabble method of successive division (don't skip steps!)

$$111/2 = 55/2 = 27/2 = 13/2 = 6/2 = 3/2 = 1/2 = 0$$

$$111 = 110111$$

### Adding Unsigned Binary Numbers

8. Add 7 + 5 in binary.

First convert to binary, then compute the sum.

$$7/2 = 3/2 = 1/2 = 1 \quad \bigg| \quad 5/2 = 2/2 = 1/2 = 0$$

$$7 = 0111 \quad \quad \quad 5 = 0101$$

$$\begin{array}{r} 0111 \\ + 0101 \\ \hline 1100 \end{array}$$

### Adding Signed Binary Numbers (with Negatives)

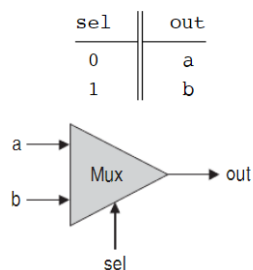
9. Add  $7 + (-5)$  in binary. Same as subtraction.  
First convert to binary, then compute the sum.

$$\begin{array}{r}
 \phantom{0}0111 \\
 + 1011 \\
 \hline
 1\leftarrow 0010
 \end{array}$$

### Multiplexor (Mux) Design

10. Write the Boolean function for the output (out). Use K-maps if needed.  
Then write the HDL code.

a	b	sel	out
0	0	0	0
0	1	0	0
1	0	0	1
1	1	0	1
0	0	1	0
0	1	1	1
1	0	1	0
1	1	1	1



out(a,b,sel) =

CHIP Mux {  
  IN a, b, sel;  
  OUT out;

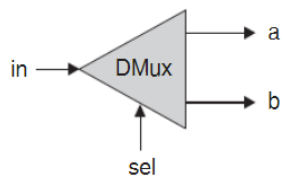
PARTS:

}

**Demultiplexor (DMux) Design**

11. Write the Boolean function for the output (out). Use K-maps if needed.  
Then write the HDL code.

sel	a	b
0	in	0
1	0	in



a(in, sel) =

b(in, sel) =

```
CHIP DMux {
  IN in, sel;
  OUT a, b;
```

PARTS:

```
}
```