

## EGC221: Digital Logic Lab

### Experiment #4 Combinational Logic Circuit Reduction

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#### Assessment:

Assessment Point	Weight	Grade
Methodology and correctness of results		
Discussion of results		
Participation		
<b>Assessment Points' Grade:</b>		

#### Comments:


**Experiment #4:****Circuit Reduction Techniques****Objectives:**

The objectives of this experiment are to:

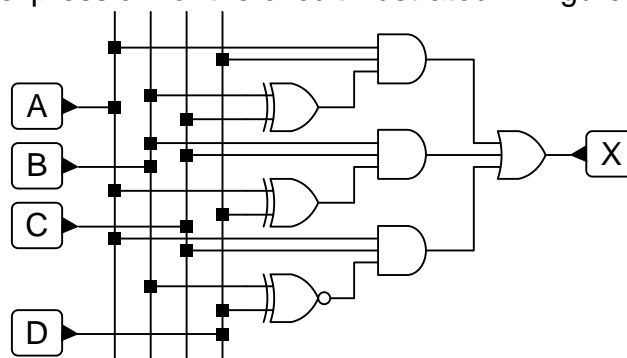
1. Obtain simplified expressions in the form of Sum-of-Products,
2. Simplify a logic circuit using Boolean algebra.

**Procedure:**

Use Logisim to solve the following exercises.

**Exercise 1:**

(a) Derive the logic expression for the circuit illustrated in Figure 1.



**Figure 1.** Basic Logic Circuit with four inputs A, B, C, and D.

<b>Logic Expression:</b>	X =
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Note: In MS Word, you can type **2295 Alt x** to generate  $\oplus$  symbol.

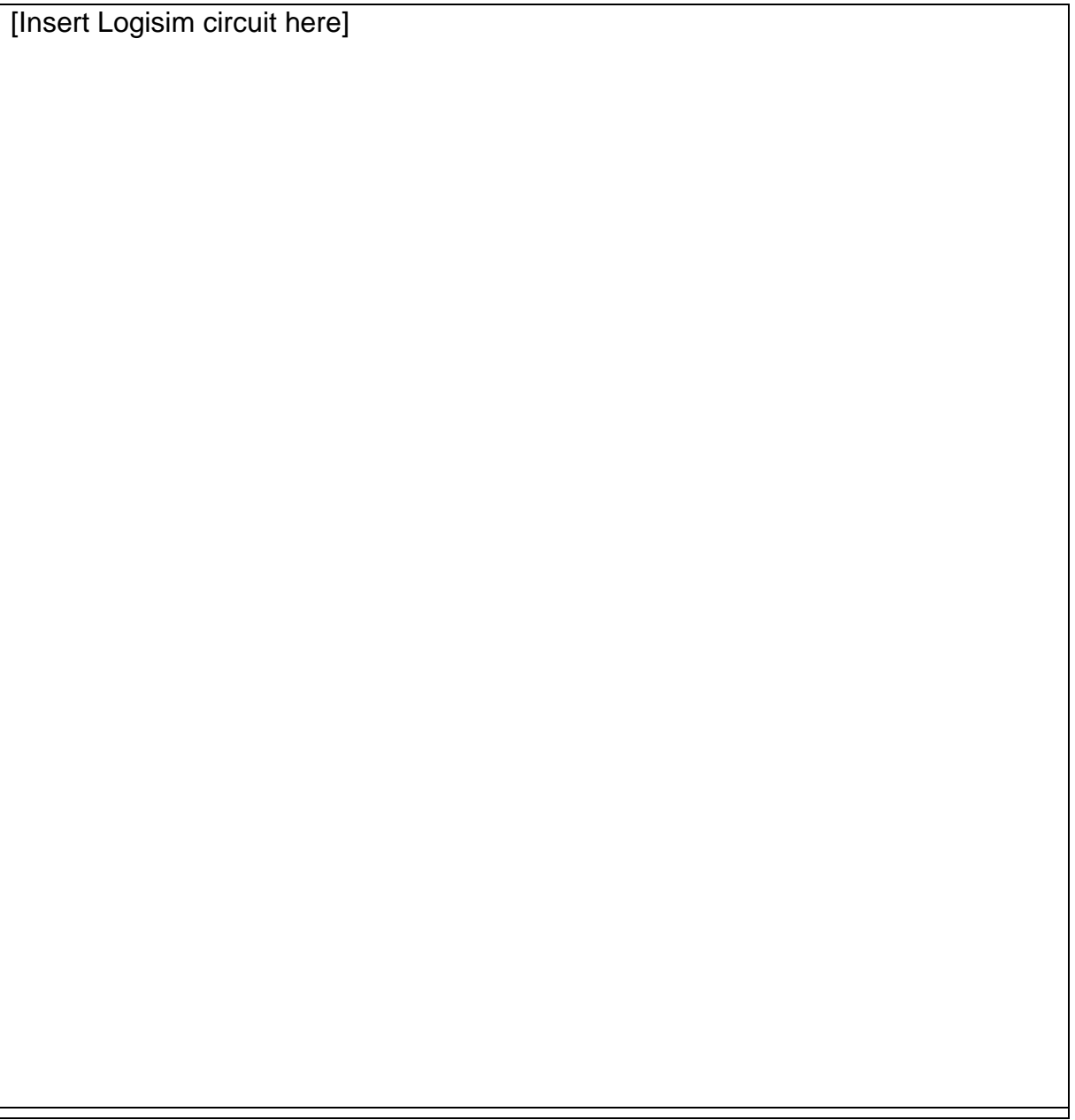
(b) Analyze the circuit in Figure 1 and **complete** Table 1 below.

**Table 1.** Basic Logic Circuit with four inputs A, B, C, and D.

A	B	C	D							
0	0	0	0							
0	0	0	1							
0	0	1	0							
0	0	1	1							
0	1	0	0							
0	1	0	1							
0	1	1	0							
0	1	1	1							
1	0	0	0							
1	0	0	1							
1	0	1	0							
1	0	1	1							
1	1	0	0							
1	1	0	1							
1	1	1	0							
1	1	1	1							

(c) Use Logisim to simulate the non-simplified circuit. Complete **Figure 2** and **Table 2**.

[Insert Logisim circuit here]



**Figure 2.** Non-simplified circuit simulation

**Table 2.** Non-simplified circuit truth table based on simulation

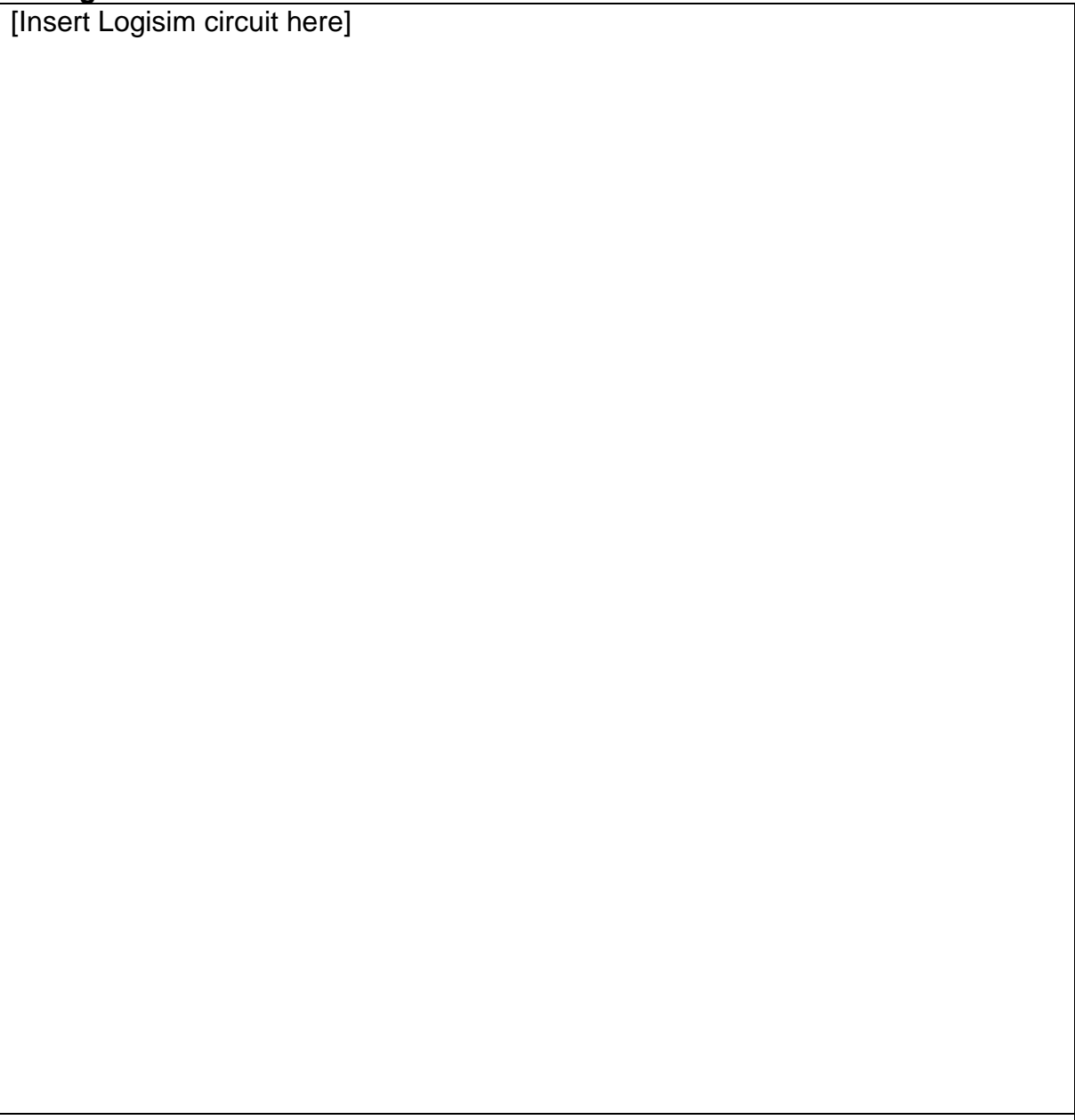
A	B	C	D	X
0	0	0	0	
0	0	0	1	
0	0	1	0	
0	0	1	1	
0	1	0	0	
0	1	0	1	
0	1	1	0	
0	1	1	1	
1	0	0	0	
1	0	0	1	
1	0	1	0	
1	0	1	1	
1	1	0	0	
1	1	0	1	
1	1	1	0	
1	1	1	1	

(d) Use the results from **Table 2** to derive the Sum of Min Terms and Standard Sum-of-Products expression for X.

<b>Sum of Min-term Expression:</b>	X =
<b>SoP Expression:</b>	X =

(e) Use Logisim to simulate the non-simplified Sum Of Products circuit. Complete **Figure 3** and **Table 3**.

[Insert Logisim circuit here]



**Figure 3.** Non-simplified SOP circuit simulation

**Table 3.** Non-simplified SOP circuit truth table based on simulation

A	B	C	D	X
0	0	0	0	
0	0	0	1	
0	0	1	0	
0	0	1	1	
0	1	0	0	
0	1	0	1	
0	1	1	0	
0	1	1	1	
1	0	0	0	
1	0	0	1	
1	0	1	0	
1	0	1	1	
1	1	0	0	
1	1	0	1	
1	1	1	0	
1	1	1	1	

- (f) Use Boolean algebra to simplify X, from part (e). See basic Boolean identities (Postulate and Theorems) and identify line-by-line Simplify X and verify the Sum-of-Products expression for X.

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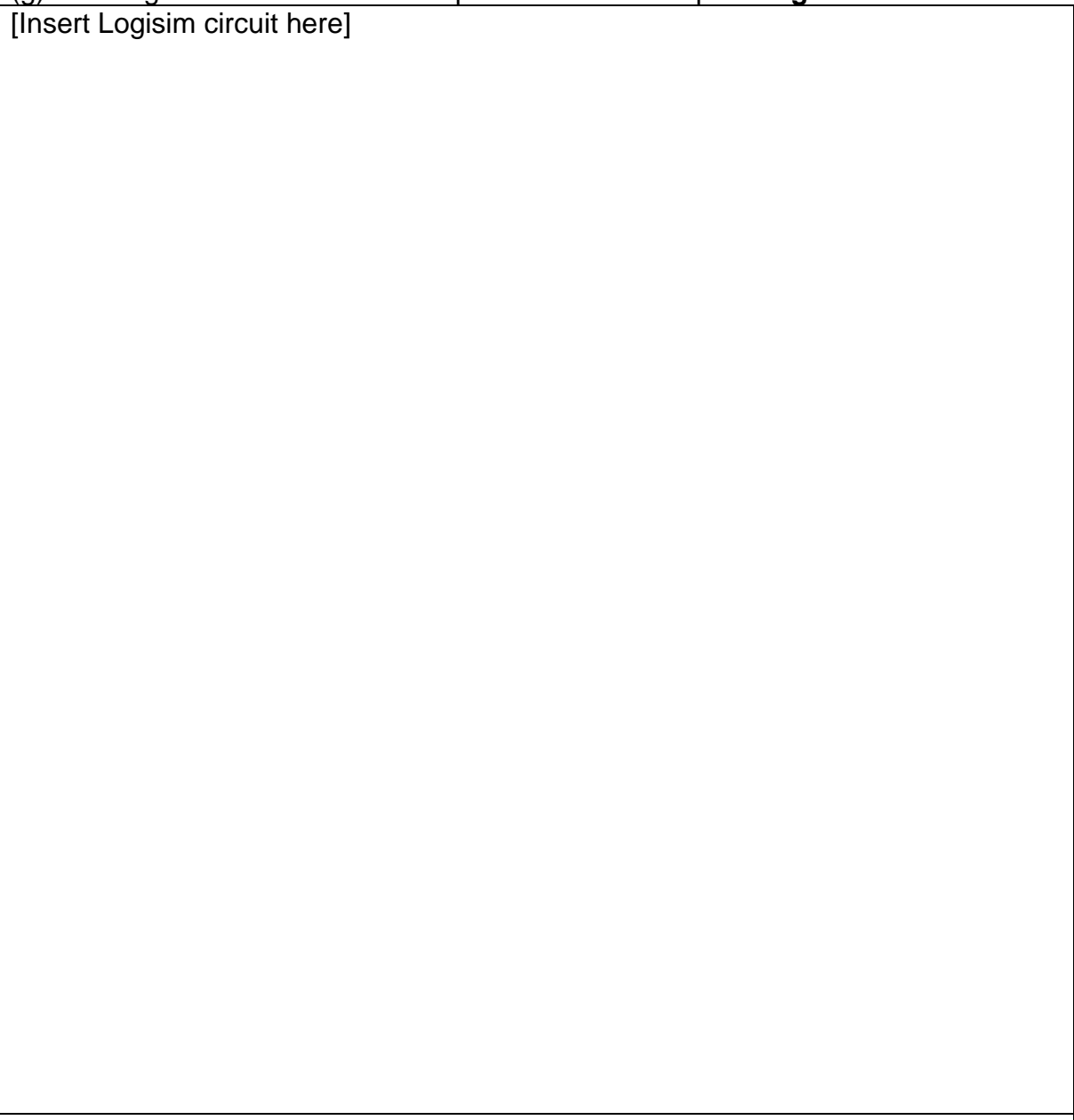
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**Minimum SoP  
Expression:**

X =

(g) Use Logisim to simulate the simplified circuit. Complete **Figure 4** and **Table 4**.

[Insert Logisim circuit here]



**Figure 4.** Simplified circuit simulation

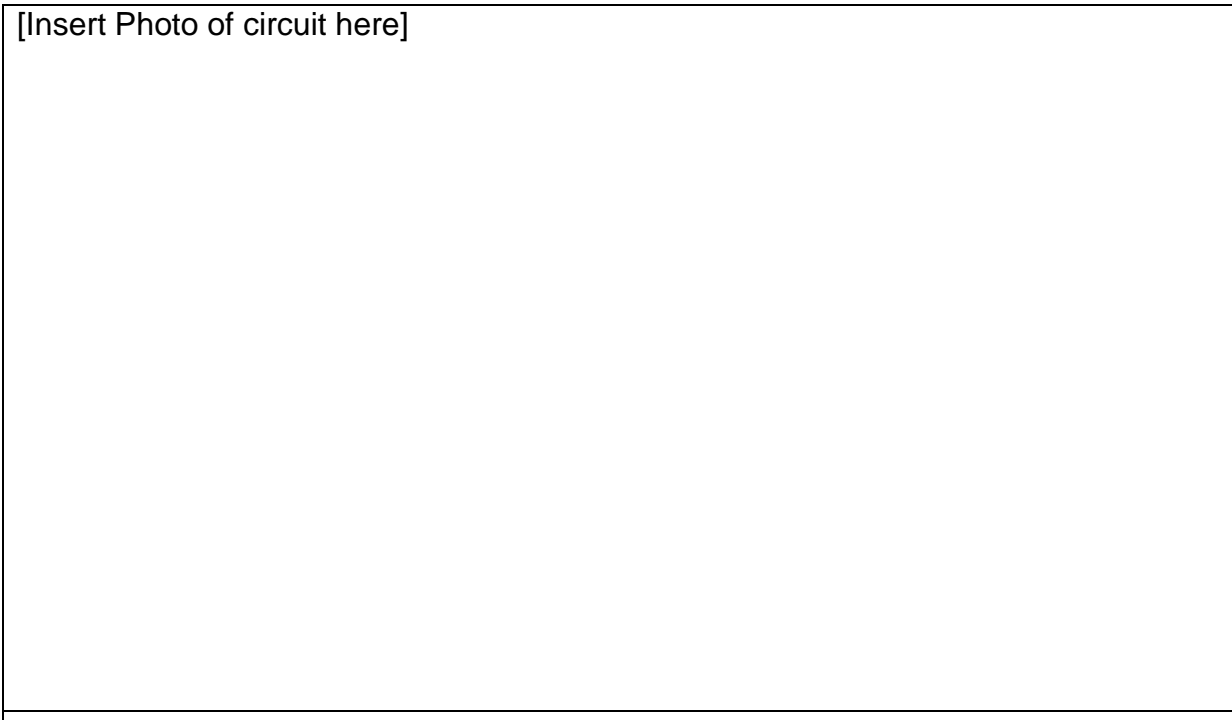


**Table 4.** Simplified circuit truth table based on simulation

A	B	C	D	X
0	0	0	0	
0	0	0	1	
0	0	1	0	
0	0	1	1	
0	1	0	0	
0	1	0	1	
0	1	1	0	
0	1	1	1	
1	0	0	0	
1	0	0	1	
1	0	1	0	
1	0	1	1	
1	1	0	0	
1	1	0	1	
1	1	1	0	
1	1	1	1	

(h) Verify the operation of your simplified circuit using a Digital I/O Module, DC Power Supply, Breadboard, ICs, and Wires. Complete **Figure 5** and **Table 5**.

[Insert Photo of circuit here]

**Figure 5.** Combinational circuit photo

**Table 5.** Simplified circuit truth table based on build

A	B	C	D	X
0	0	0	0	
0	0	0	1	
0	0	1	0	
0	0	1	1	
0	1	0	0	
0	1	0	1	
0	1	1	0	
0	1	1	1	
1	0	0	0	
1	0	0	1	
1	0	1	0	
1	0	1	1	
1	1	0	0	
1	1	0	1	
1	1	1	0	
1	1	1	1	

(i) Conclusions (discussion of results):