

## Laboratory 2

### Boolean Expressions using Universal Gates-

#### 1. Introduction and Purpose of Experiment

Students will learn to simulate and implement logic circuits using only universal gates.

#### 2. Aim and Objectives

**Aim:** To simulate and implement logic circuits using only NAND and NOR gates

**Objectives:** At the end of this lab, the student will be able to

- Use Logisim to simulate Boolean circuits using only NAND gates
- Describe the procedure to convert all the gates in a circuit to universal gates
- Draw circuit diagrams for Boolean expressions using only universal gates

#### 3. Experimental Procedure

a. Draw truth tables and circuit diagrams for the following expressions using only NAND gates.

1.  $F = AB + CD$
2.  $F = X \sim Y + \sim XY + Z$
3.  $F = A(CD + B) + BC$
4.  $F = AB + BC + AC$

b. Draw truth tables and circuit diagrams for the following expressions using only NOR gates.

1.  $F = (A + B)(C + D)E$
2.  $F = (A + B + C)(\sim A + \sim B + \sim C)$

c. Use Logisim to generate truth tables and circuit diagrams for the expressions in 3(a).

d. Implement the first three expressions in the non-minimized form and verify the truth tables. Show the output to the course leader.

- e. Why is it easier to draw a circuit diagram using universal gates if the Boolean expression is in standard/canonical form?

Your document should include:

- Handwritten truth tables and circuit diagrams for the expressions
- Logisim screenshots
- Answer to 3(e)

Solution for above questions using Logisim

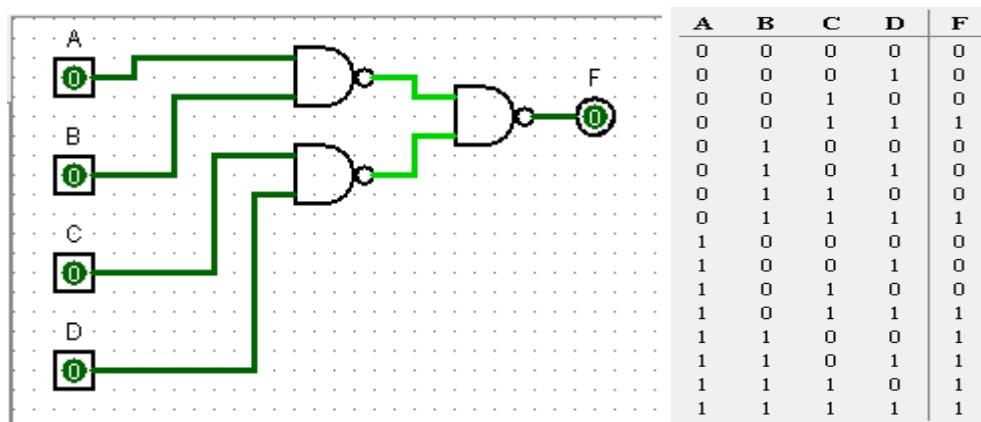


Figure 1 solution for  $F = AB + CD$

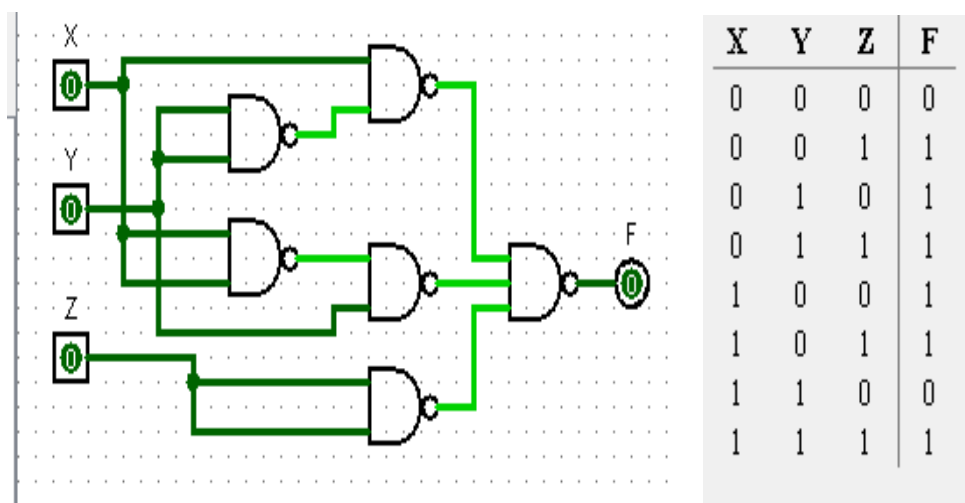


Figure 2 solution for  $F = X\sim Y + \sim XY + Z$

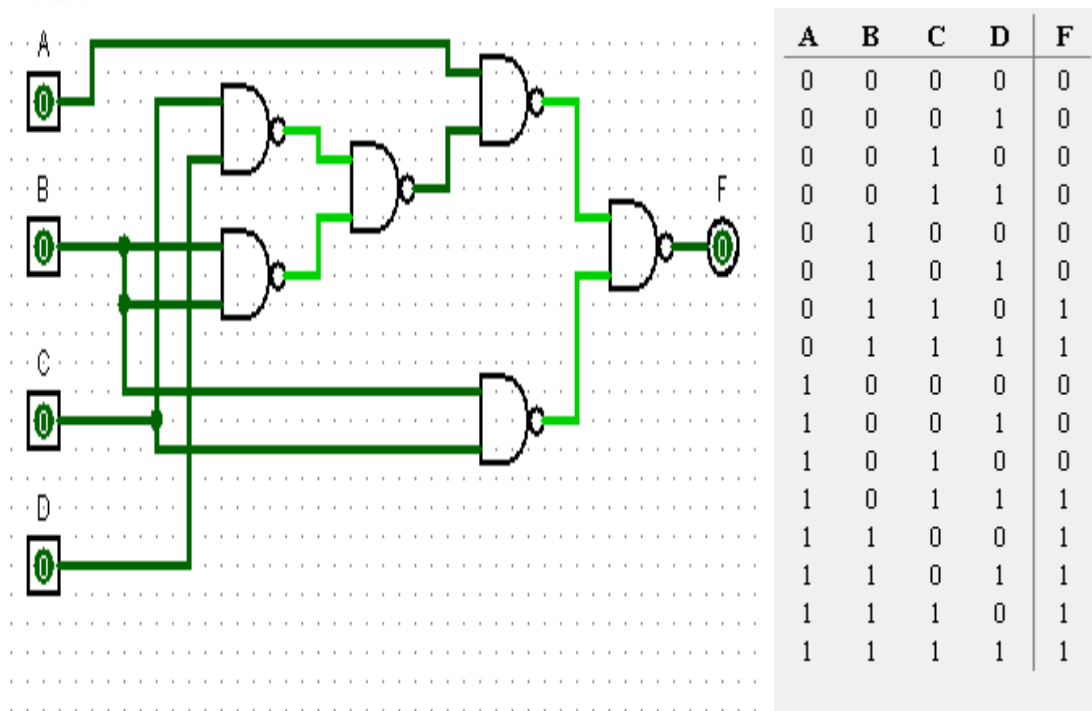


Figure 3 solution for  $F = A(CD + B) + BC$

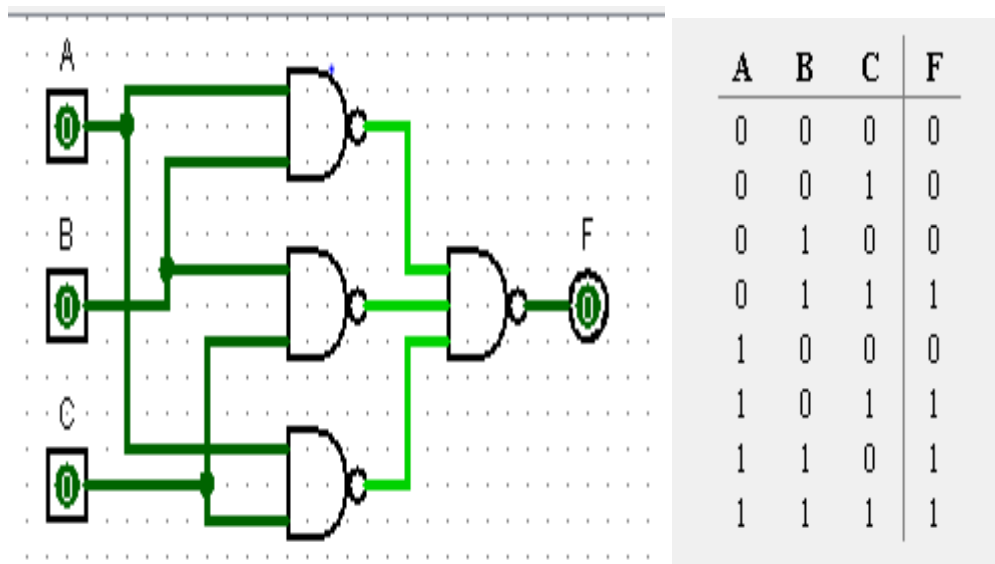


Figure 4 solution for  $F = AB + BC + AC$