German-Jordanian University
School of Electrical Engineering and Information Technology
Department of Computer Engineering

CE2120-Digital Systems Lab
Lab 3

I. Objective:

The objective of this lab is to enhance the skills of the students in designing, wiring, and testing logic circuits.

II. Preparations:

1. Consider the logic diagram below for a circuit that adds 3 bits (X, Y, Cin) and produces two outputs (S, Cout).

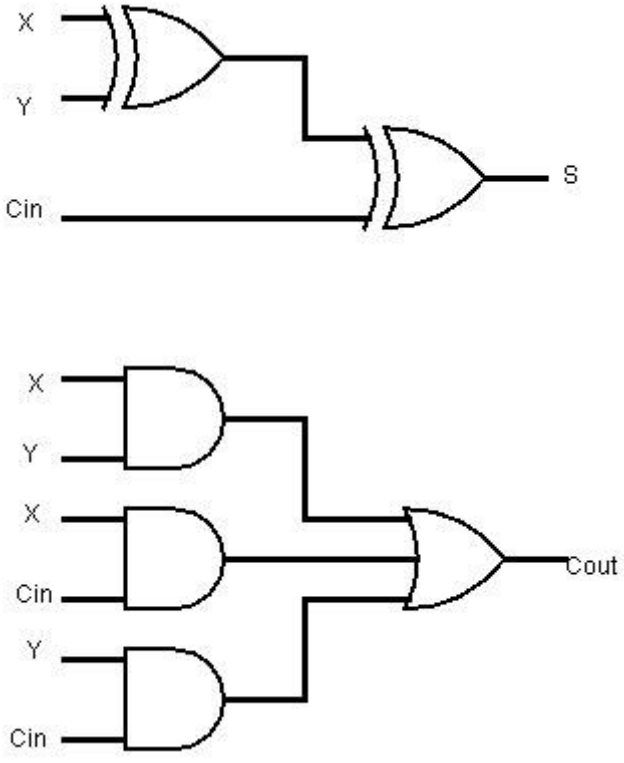

Figure 1: Full adder

a. Fill the truth table for the full adder.

X	Y	Cin	S	Cout

b. From the circuit, derive the Boolean expression that describes each output (S and Cout) in terms of the inputs (X, Y, and Cin).

2. Consider the logic diagram below for circuit that computes the 2's complement of a 4-bit binary number.

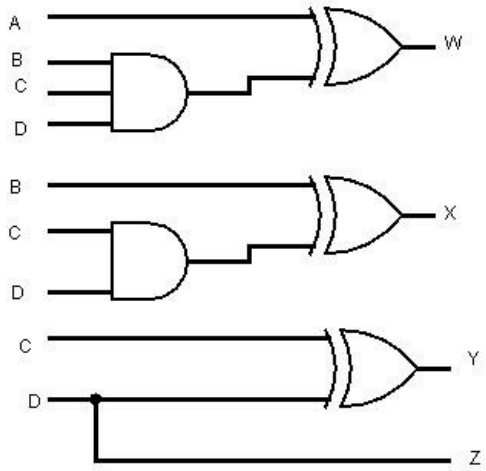

Figure 2: 4-bit 2's complement calculator

a. Fill the truth table below for the 2's complement calculator.

A	B	C	D	W	X	Y	Z

b. From the circuit, derive the Boolean expression that describes each output (W, X, Y, and Z) in terms of the inputs (A, B, C, and D).

3. Consider the logic diagram below for circuit that converts from 4-bit gray code to 4-bit binary number. Note that the 4-bit gray code is a binary code in which any two consecutive codes are differing in only one bit as shown in Table 1.

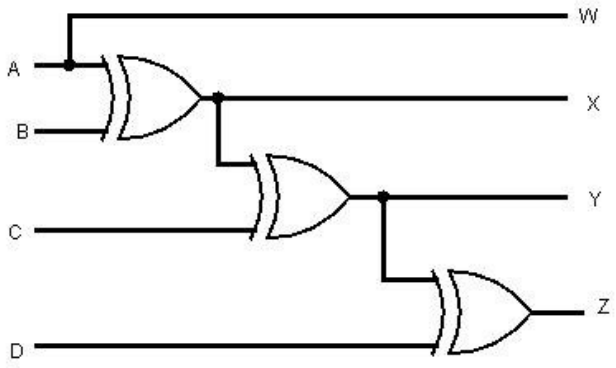

Figure 3: 4-bit gray code to 4-bit binary number

Decimal	Gray
0	0000
1	0001
2	0011
3	0010
4	0110
5	0111
6	0101
7	0100
8	1100
9	1101
10	1111
11	1110
12	1010
13	1011
14	1001
15	1000

Table 1: 4-bit gray code

a. Fill the truth table below for the 4-bit gray code to 4-bit binary convertor.

A	B	C	D	W	X	Y	Z

b. From the circuit, derive the Boolean expression that describes each output (W, X, Y, and Z) in terms of the inputs (A, B, C, and D).

III. Lab work

In this experiment:

a. Build the circuit in Figure 1 on the breadboard and verify the truth table you have obtained in part 1.a.
b. Build the circuit in Figure 2 on the breadboard and verify the truth table you have obtained in part 2.a.
c. Build the circuit in Figure 3 on the breadboard and verify the truth table you have obtained in part 3.a.