North South University

Department of Electrical & Computer Engineering

LAB REPORT

Course Name: **CSE231L**

Experiment No: 04

Experiment Name: Combinational Logic Design

Experiment Date: 29/11/20

Report Submission Date: 06/12/20

Section:

Student Name: Koushik Banerjee	Score
Student ID: **1812171642**	

Remarks:	

LAB-04: Combinational Logic Design (BCD to Excess-3 Converter)

Objectives:

- Design a complete minimal combinational logic system from specification to implementation.
- Minimize combinational logic circuits using Karnaugh maps.
- Learn various numerical representation systems.
- Implement circuits using canonical minimal forms.

Equipment list:

- Trainer Board
- 1 x IC 4073 Triple 3-input AND gates
- 1 x IC 4075 Triple 3-input OR gates
- 1 x IC 7404 Hex Inverters (NOT gates)
- 1 x IC 7400 2-input NAND gates
- 2 x IC 7408 2-input AND gates

Theory:

K-Map: The K-map method of solving the logical expressions is referred to as the graphical technique of simplifying Boolean expressions. ... K-maps basically deal with the technique of inserting the values of the output variable in cells within a rectangle or square grid according to a definite pattern. Example. Karnaugh maps are used to facilitate the simplification of Boolean algebra functions. ... Following are two different notations describing the same function in unsimplified Boolean algebra, using the Boolean Variables A, B, C, D, and their inverses. Karnaugh maps take truth tables and provide a visual way to produce a much simpler formula for expressing the same logic. ... The disadvantage of k map: It is not suitable for computer reduction. It is not suitable when the number of variables involved exceed four. A Karnaugh map (K-map) is a pictorial method used to minimize Boolean expressions without having to use Boolean algebra theorems and equation manipulations. A K-map can be thought of as a special version of a truth table. Using a K-map, expressions with two to four variables are easily minimized.

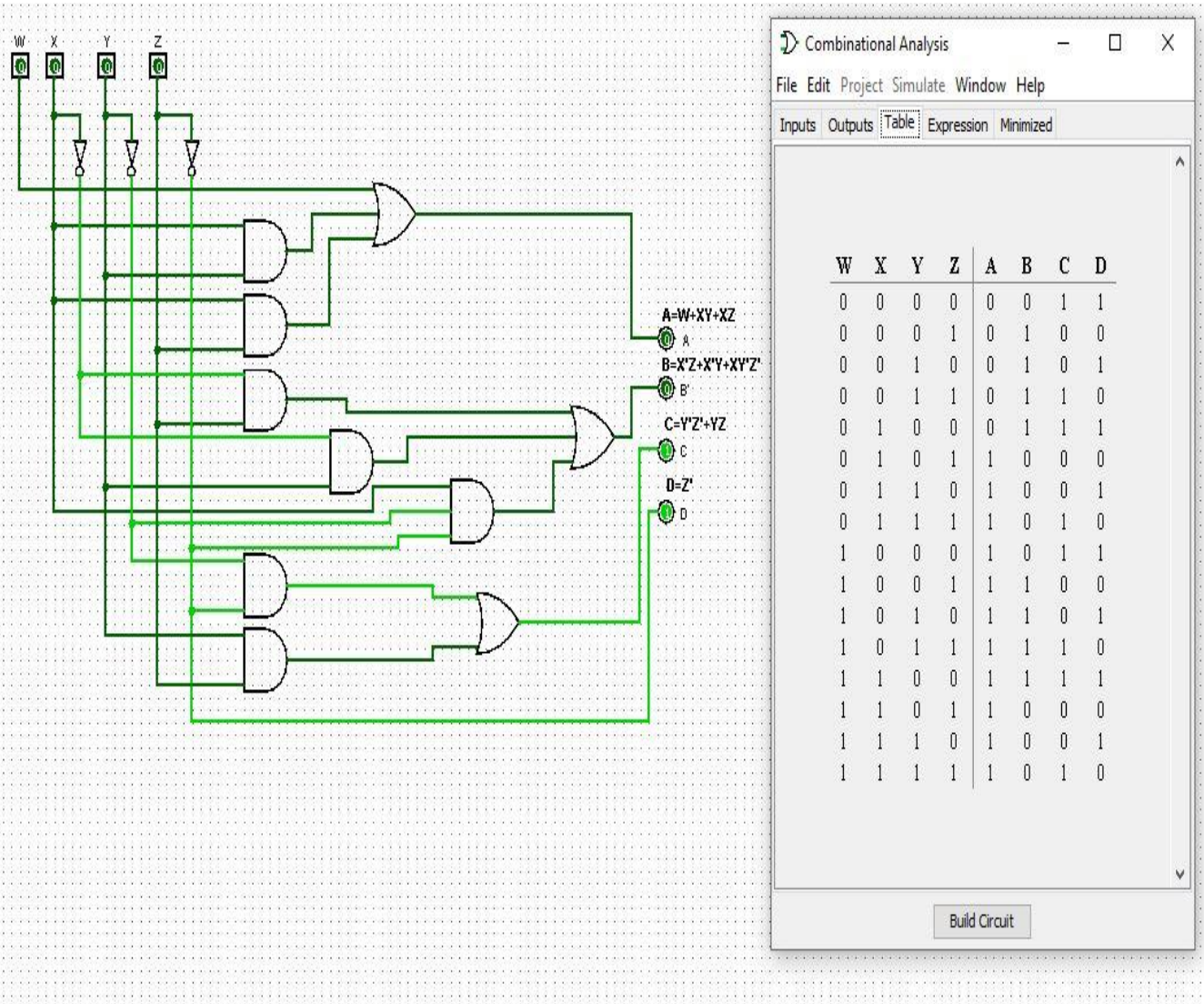
BCD to Excess-3 :

The conversion from binary coded decimal to decimal is the exact opposite of the above. Simply divide the binary number into groups of four digits, starting with the least significant digit and then write the decimal digit represented by each 4-bit group. Short for binary-coded decimal, BCD is also known as packet decimal and is numbers 0 through 9 converted to four-digit binary. Using this conversion, the number 25, for example, would have a BCD number of 0010 0101 or 00100101. ... However, in binary, 25 is represented as 11001. Excess-3 code can be derived from BCD code by adding 3 to each number. For example, Decimal number 12 is represented as 0001 0010 in BCD. If we add 3 that is to add 0011 0011 then the corresponding Excess-3 code is 0100 0101.

Circuit Diagrams:

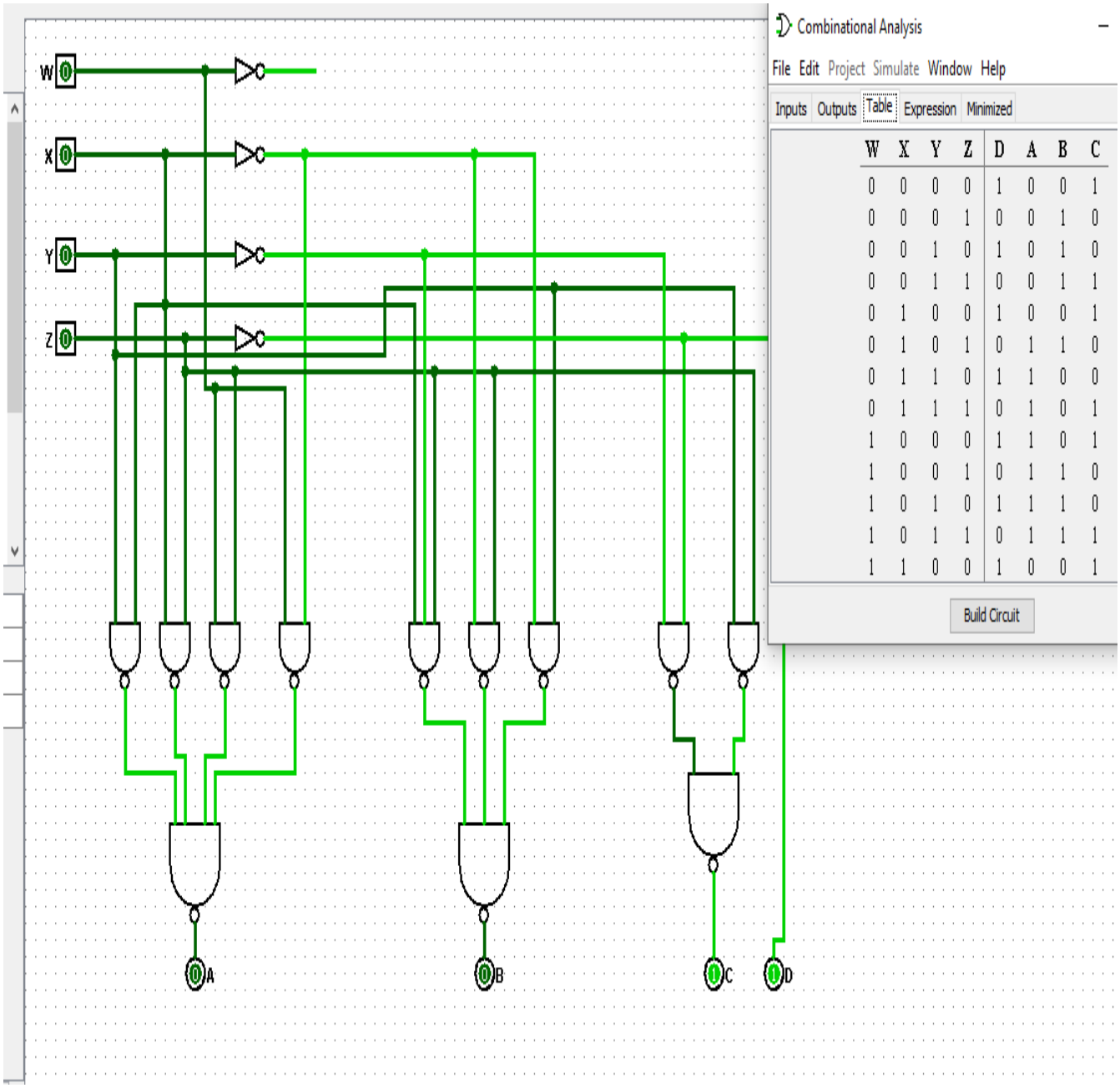
A *circuit diagram* (*electrical diagram*, elementary *diagram*, electronic *schematic*) is a graphical representation of an *electrical circuit*. ... The presentation of the interconnections between *circuit* components in the *schematic diagram* does not necessarily correspond to the physical arrangements in the finished device.

Figure F1: Minimal logic circuit of BCD to Excess-3 converter.



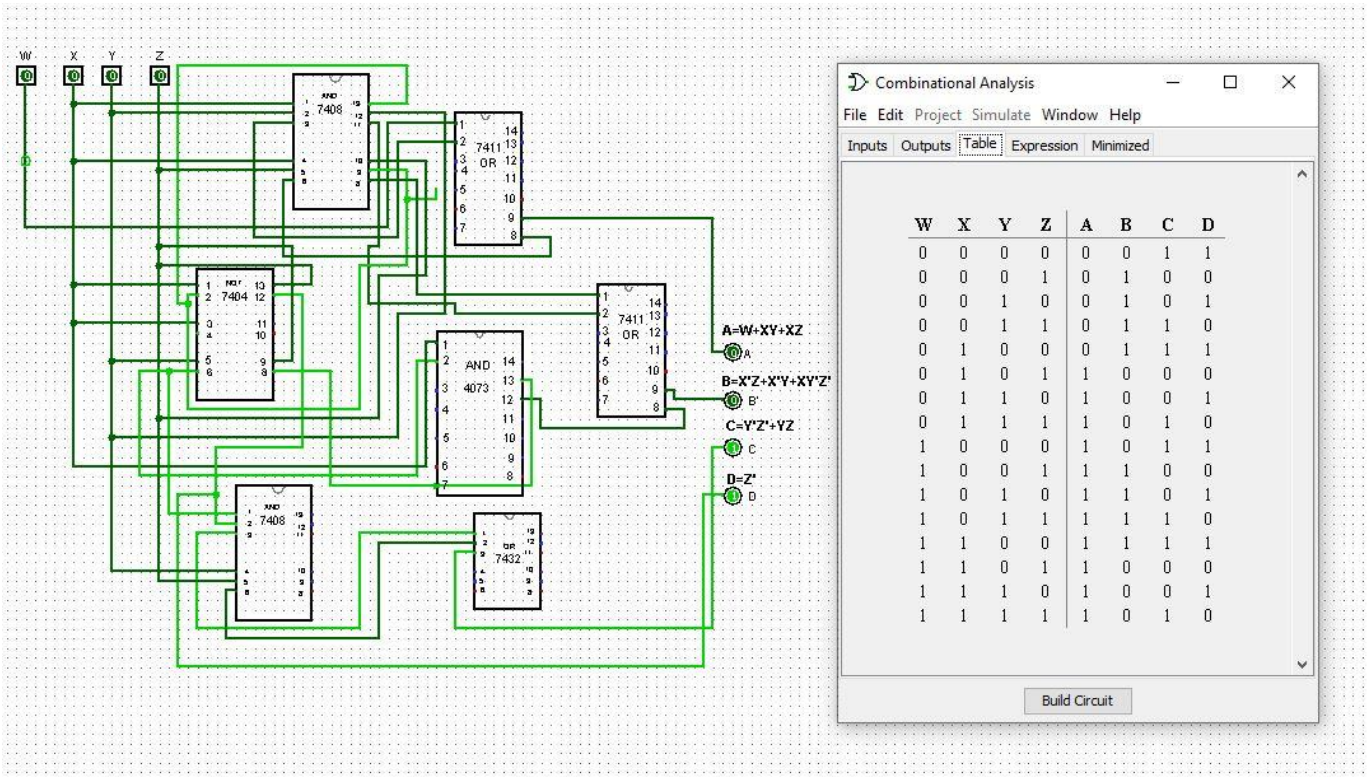
W	X	Y	Z	A	B	C	D
0	0	0	0	0	0	1	1
0	0	0	1	0	1	0	0
0	0	1	0	0	1	0	1
0	0	1	1	0	1	1	0
0	1	0	0	0	1	1	1
0	1	0	1	1	0	0	0
0	1	1	0	1	0	0	1
0	1	1	1	1	0	1	0
1	0	0	0	1	0	1	1
1	0	0	1	1	1	0	0
1	0	1	0	1	1	0	1
1	0	1	1	1	1	1	0
1	1	0	0	1	1	1	1
1	1	0	1	1	0	0	0
1	1	1	0	1	0	0	1
1	1	1	1	1	0	1	0

Figure F2: Minimal universal gate implementation of BCD to Excess-3 converter.



W	X	Y	Z	D	A	B	C
0	0	0	0	1	0	0	1
0	0	0	1	0	0	1	0
0	0	1	0	1	0	1	0
0	0	1	1	0	0	1	1
0	1	0	0	1	0	0	1
0	1	0	1	0	1	1	0
0	1	1	0	1	1	0	0
0	1	1	1	0	1	0	1
1	0	0	0	1	1	0	1
1	0	0	1	0	1	1	0
1	0	1	0	1	1	1	0
1	0	1	1	0	1	1	1
1	1	0	0	1	0	0	1

Figure F4: minimal IC implementation of BCD to Excess-3 converter:



W	X	Y	Z	A	B	C	D
0	0	0	0	0	0	1	1
0	0	0	1	0	1	0	0
0	0	1	0	0	1	0	1
0	0	1	1	0	1	1	0
0	1	0	0	0	1	1	1
0	1	0	1	1	0	0	0
0	1	1	0	1	0	0	1
0	1	1	1	1	0	1	0
1	0	0	0	1	0	1	1
1	0	0	1	1	1	0	0
1	0	1	0	1	1	0	1
1	0	1	1	1	1	1	0
1	1	0	0	1	1	1	1
1	1	0	1	1	0	0	0
1	1	1	0	1	0	0	1
1	1	1	1	1	0	1	0

Figure F3: K-Maps.

0	0	0	0
0	1	1	1
X	X	X	X
1	1	X	X

A =WX'+XZ+XY

0	1	1	1
1	0	0	0
X	X	X	X
X	1	X	X

B=X'Z+X'Y+XY'Z'

1	0	1	0
1	0	1	0
X	X	X	X
1	0	X	X

C=Y'Z'+YZ

1	0	0	1
1	0	0	1
X	X	X	X
1	0	X	X

D=Z'

Data Table:

Table 01: Truth table of the given circuit using universal gates

Decimal Digit	Binary Coded Decimal (BCD)				EXCESS-3			
	W	X	Y	Z	A	B	C	D
0	0	0	0	0	0	0	1	0
1	0	0	0	1	0	1	0	0
2	0	0	1	0	0	1	0	1
3	0	0	1	1	0	1	1	0
4	0	1	0	0	0	1	1	1
5	0	1	0	1	1	0	0	0
6	0	1	1	0	0	0	0	1
7	0	1	1	1	1	0	1	0
8	1	0	0	0	1	0	1	1
9	1	0	0	1	1	1	0	0

Discussion:

In lab 4 and in the lab class I face couple of problem doing the IC circuit, I had done mistake in min terms but I solve that out by following the equation. But this lab was pretty simple. It took some time but finally I found out where the problem was and fix IC circuit and then solved it properly. By the help of our class lab instructor I fix that problem also. That was all human e error problem. After understanding all the problem and practicing that problem, I answered all the questions.