Experiment No. 2

Title: To Design and Simulate binary to gray, gray to binary, BCD to Excess 3, Excess 3 to BCD code converters.

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Batch:B3   **Roll No.: 16010422185**   **Experiment No.: 2**

Aim: To Design and Simulate binary to gray, gray to binary, BCD to Excess 3, Excess 3 to BCD code converters.

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Resources needed: Simulation Platform(VLabs)

Theory:

Binary Codes:
A symbolic representation of data/ information is called code. The base or radix of the binary number is 2. Hence, it has two independent symbols. The symbols used are 0 and 1. A binary digit is called as a bit. A binary number consists of sequence of bits, each of which is either a 0 or 1. Each bit carries a weight based on its position relative to the binary point. The weight of each bit position is one power of 2 greater than the weight of the position to its immediate right. e. g. of binary number is 100011 which is equivalent to decimal number 35.

BCD Codes:

Numeric codes represent numeric information i.e. only numbers as a series of 0's and 1's. Numeric codes used to represent decimal digits are called Binary Coded Decimal (BCD) codes. A BCD code is one, in which the digits of a decimal number are encoded-one at a time into group of four binary digits. There are a large number of BCD codes in order to represent decimal digits0, 1, 2,....,9, it is necessary to use a sequence of at least four binary digits. Such a sequence of binary digits which represents a decimal digit is called code word.

Gray Codes:

It is a non-weighted code; therefore, it is not a suitable for arithmetic operations. It is a cyclic code because successive code words in this code differ in one bit position only i.e. it is a unit distance code.

Applications of Gray Code:

- In instrumentation and data acquisition system where linear or angular displacement is measured.
- In shaft encoders, input-output devices, A/D converters and the other peripheral equipment.

Excess-3 code:

It is a non-weighted code. It is also a self-complementing BCD code used in decimal arithmetic units. . The Excess-3 code for the decimal number is performed in the same

manner as BCD except that decimal number 3 is added to the each decimal unit before encoding it to binary.

Code Converters:

The availability of a large variety of codes for the same discrete elements of information results in the use of different codes by different digital systems. It is some time necessary to use the output of one system as the input to the other. The conversion circuit must be inserted between the two systems if each uses different codes for the same information. Thus a code converter is a circuit that makes the two systems compatible even though each uses the different code.
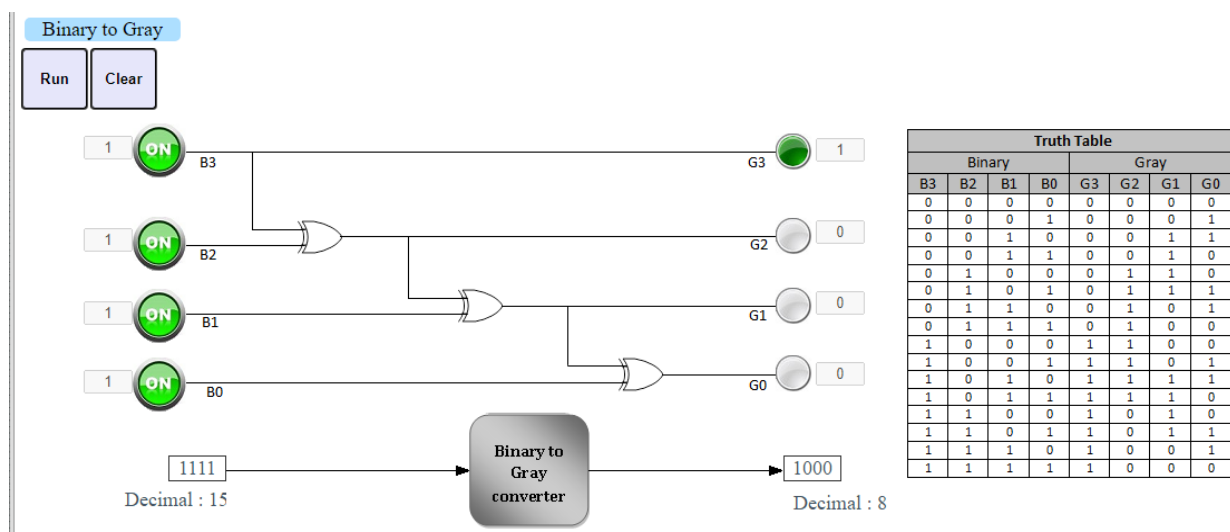
Procedure:

1. Select appropriate code converter from tab menu.
2. Run / execute the simulation by pressing the run button and observe the output of code converters on the output LED.
3. Repeat the procedure for different inputs and note down the corresponding outputs.

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Observations and Results:

1)Binary to Gray:

Eqn: $g_{(n-1)} = b_{(n-1)} \oplus b_n$, $g_n = b_n$

Truth Table							
Binary				Gray			
B3	B2	B1	B0	G3	G2	G1	G0
0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	1
0	0	1	0	0	0	1	1
0	0	1	1	0	0	1	0
0	1	0	0	0	1	1	0
0	1	0	1	0	1	1	1
0	1	1	0	0	1	0	1
0	1	1	1	0	1	0	0
1	0	0	0	1	1	0	0
1	0	0	1	1	1	0	1
1	0	1	0	1	1	1	1
1	0	1	1	1	1	1	0
1	1	0	0	1	0	1	0
1	1	0	1	1	0	1	1
1	1	1	0	1	0	0	1
1	1	1	1	1	0	0	0

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2)Gray to Binary:
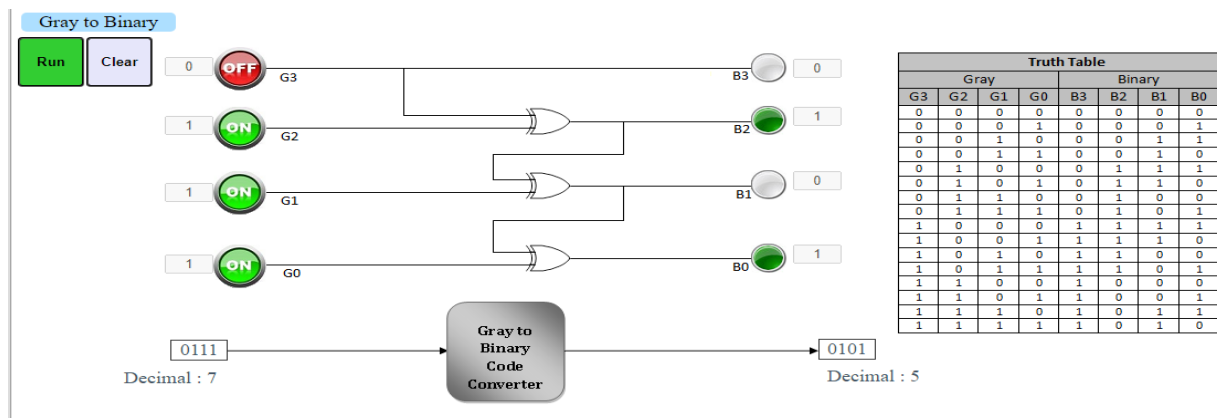
Eqn:

$$A = (G3 \oplus G2) \oplus (G1 \oplus G0)$$

$$B = G3 \oplus G2 \oplus G1$$

$$C = G3 \oplus G2$$

$$D = G3$$

Truth Table							
Gray				Binary			
G3	G2	G1	G0	B3	B2	B1	B0
0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	1
0	0	1	0	0	0	1	1
0	0	1	1	0	0	1	0
0	1	0	0	0	1	1	1
0	1	0	1	0	1	1	0
0	1	1	0	0	1	0	0
0	1	1	1	0	1	0	1
1	0	0	0	1	1	1	1
1	0	0	1	1	1	1	0
1	0	1	0	1	1	0	0
1	0	1	1	1	1	0	1
1	1	0	0	1	0	0	0
1	1	0	1	1	0	0	1
1	1	1	0	1	0	1	1
1	1	1	1	1	0	1	0

3)BCD to Excess:

Eqn: z = D y = CD+C'D'=CD(C+D)' x = B'C+B'D+BC'D'= B'(C+D) +BC'D' x = B'(C+D) +B(C+D)' w = A+BC+BD=A+B(C+D)

Truth Table							
BCD				Excess-3			
B3	B2	B1	B0	E3	E2	E1	E0
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
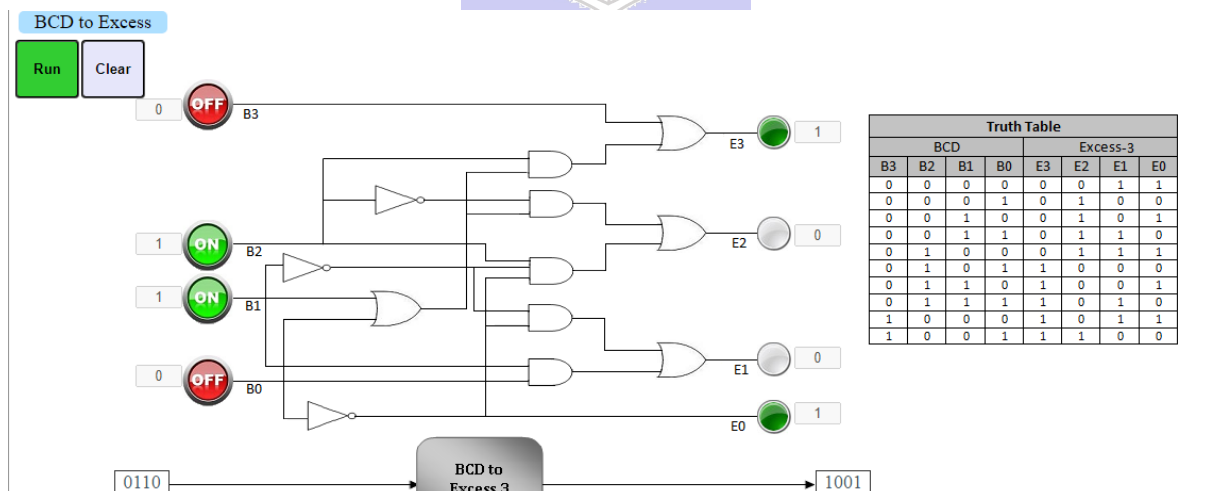
4)Excess to BCD:

Eqn:

$$w = A + BC + BD$$
$$x = B'C + B'D + BC'D'$$
$$y = CD + C'D'$$
$$z = D'$$

| Excess-3 to BCD |
| Run | Clear |

Truth Table

Excess-3				BCD			
E3	E2	E1	E0	B3	B2	B1	B0
0	0	1	1	0	0	0	0
0	1	0	0	0	0	0	1
0	1	0	1	0	0	1	0
0	1	1	0	0	0	1	1
0	1	1	1	0	1	0	0
1	0	0	0	0	1	0	1
1	0	0	1	0	1	1	0
1	0	1	0	0	1	1	1
1	0	1	1	1	0	0	0
1	1	0	0	1	0	0	1

Excess 3 to BCD Converter

0011   Decimal : 3   0000   Decimal : 0
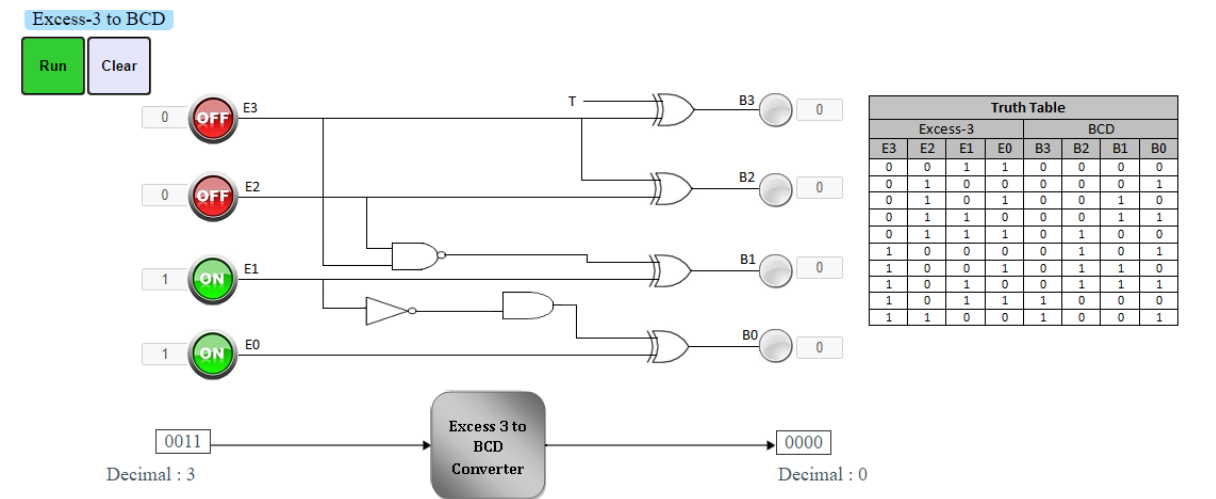
Conclusion:

We learned how to convert binary to gray, gray to binary, BCD to excess 3, excess 3 to BCD, and how to draw their logic circuits in this experiment.

Grade: AA / AB / BB / BC / CC / CD /DD

Signature of faculty in-charge with date

1. References:Virtual lab
2. Books/ Journals/ Websites:
3. 1. R. P. Jain, "Modern Digital Electronics", Tata McGraw Hill.
4. 2. http://www.allaboutcircuits.com/worksheets/basic-logic-gates/

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