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NATIONAL INSTITUTE OF TECHNOLOGY SILCHAR

CACHAR, ASSAM

LABORATORY EXERCISE BOOK

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BRANCH: CSE - 'B'

SUBJECT: CIRCUIT AND SWITCHING LAB

CODE : EC-222

18/11/2020
Experiment-01

AIM: TO ANALYSE TRUTH TABLE OF BINARY TO GRAY AND GRAY TO BINARY CONVERTER USING COMBINATION OF NAND GATES AND TO UNDERSTAND THE WORKING OF BINARY TO GRAY AND GRAY TO BINARY CONVERTER WITH THE HELP OF LED DISPLAY

THEORY:

Binary Numbers is a default way to store numbers. On the other hand, Gray Code has property that two successive numbers differ in only one bit; because of this property Gray Code does the cycling through various states with minimal effort and is used in K-maps, error correction, communication etc. In computer science, many a times we need to convert binary code to gray code and vice versa. This conversion can be done by applying following rules.

1) Binary to Gray Conversion:

i. The MSB of Gray Code is always equal to the MSB of the given binary code.

ii. Other bits of the output in the gray code can be obtained by XORing binary code bit at that index and previous index.

There are four inputs and four outputs. The input variables are defined as B3, B2, B1, B0 and the output variables are defined as G3, G2, G1, G0. From the truth table, combinational table is designed. The logical expressions are defined as:

$$B3 = G3$$
$$B2 \oplus B3 = G2$$
$$B1 \oplus B2 = G1$$
$$B0 \oplus B1 = G0$$

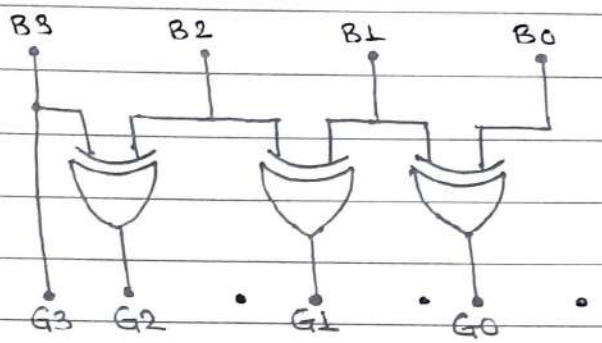

fig.1(a) Binary to Gray Code Converter Circuit

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

fig.1(b) Binary to Gray Code Truth Table

2) Gray to Binary Conversion

i. The MSB of the binary code is always equal to the MSB of the given binary number.

ii. Other bits of the output binary code can be obtained by checking gray code bit at that index. If current gray code bit is 0, then copy previous binary code bit.

There are four inputs and four outputs. The input variables are defined as G3, G2, G1, G0 and the output variables are defined as B3, B2, B1, B0. From the truth table, combinational circuit is designed. The logical expressions are defined as:

$$G0 \oplus G1 \oplus G2 \oplus G3 = B0$$

$$G1 \oplus G2 \oplus G3 = B1$$

$$G2 \oplus G3 = B2$$

$$G3 = B3$$

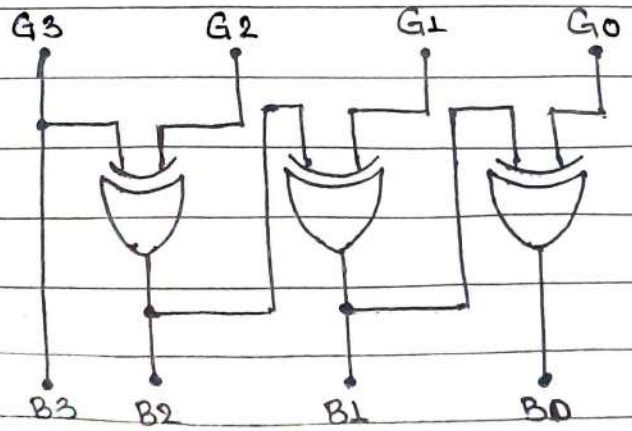

fig. 1: Gray to Binary Code Converter Circuit

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

fig.1(iv): Gray to Binary Code Truth Table

Circuit Diagram

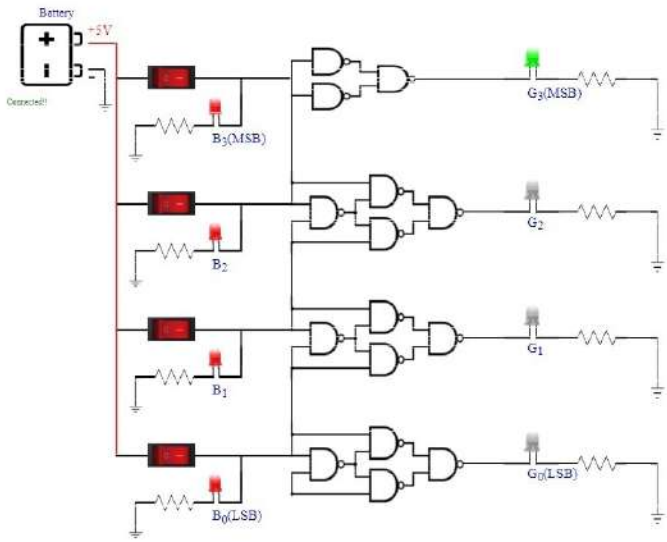

fig. 1 (v): Construction of Binary to Gray Converter using NAND gates only

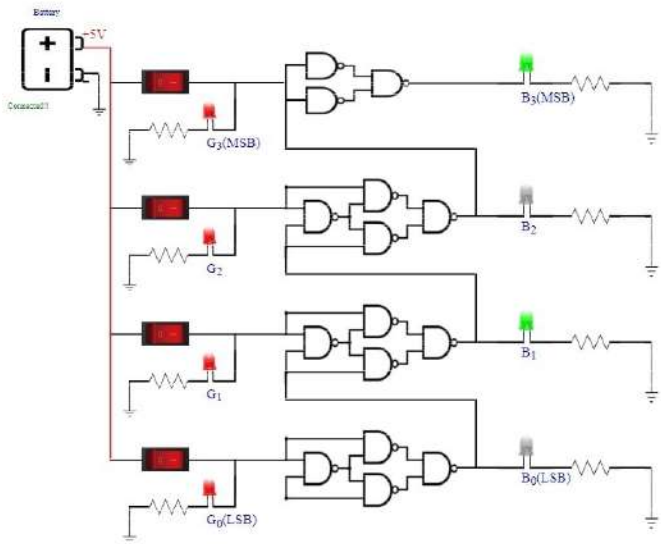

fig. 1 (vi): Construction of Gray to Binary Converter using NAND gates only

Observation

TRUTH TABLE

Serial No.	Binary				Gray			
	B_3 (MSB)	B_2	B_1	B_0 (LSB)	G_3 (MSB)	G_2	G_1	G_0 (LSB)
1	0	0	0	0	0	0	0	0
2	0	0	0	1	0	0	0	1
3	0	0	1	0	0	0	1	1
4	0	0	1	1	0	0	1	0
5	0	1	0	0	0	1	1	0
6	0	1	0	1	0	1	1	1
7	0	1	1	0	0	1	0	1
8	0	1	1	1	0	1	0	0
9	1	0	0	0	1	1	0	0
10	1	0	0	1	1	1	0	1
11	1	0	1	0	1	1	1	1
12	1	0	1	1	1	1	1	0
13	1	1	0	0	1	0	1	0
14	1	1	0	1	1	0	1	1
15	1	1	1	0	1	0	0	1
16	1	1	1	1	1	0	0	0

fig. 1 (vii) : Binary to Gray Conversion Truth Table

TRUTH TABLE

Serial No.	Gray				Binary			
	G_3 (MSB)	G_2	G_1	G_0 (LSB)	B_3 (MSB)	B_2	B_1	B_0 (LSB)
1	0	0	0	0	0	0	0	0
2	0	0	0	1	0	0	0	1
3	0	0	1	0	0	0	1	1
4	0	0	1	1	0	0	1	0
5	0	1	0	0	0	1	1	1
6	0	1	0	1	0	1	1	0
7	0	1	1	0	0	1	0	0
8	0	1	1	1	0	1	0	1
9	1	0	0	0	1	1	1	1
10	1	0	0	1	1	1	1	0
11	1	0	1	0	1	1	0	0
12	1	0	1	1	1	1	0	1
13	1	1	0	0	1	0	0	0
14	1	1	0	1	1	0	0	1
15	1	1	1	0	1	0	1	1
16	1	1	1	1	1	0	1	0

fig. 1 (viii) : Gray to Binary Conversion Truth Table

RESULT:

The truth table for binary code to gray code conversion was obtained as shown in fig. (vii).

The truth table for gray code to binary code conversion was obtained as shown in fig. (viii).

CONCLUSION:

After entering all the values correctly, we got the Gray codes from the binary values.

18/11/2020
Experiment-02

AIM: To Analyse the Truth Table of 4x2 Decoder (De-multiplexer) using NOT (7404) and AND (7408) logic gate ICs and 2x4 Encoder using OR (7403) logic gate IC and to understand the working of 4x2 Decoder and 2x4 Encoder circuit with the help of LEDs display.

THEORY:

Binary Code of N digits can be used to store 2N distinct elements of coded information. This is what encoders and decoders are used for. Encoders convert 2N lines of input into a code of N bits and Decoders decode the N bits into 2N lines.

1) 2x4 Decoder (De-multiplexer):

A decoder is a combinational circuit that converts binary information from n input lines to a maximum of 2^n unique output lines.

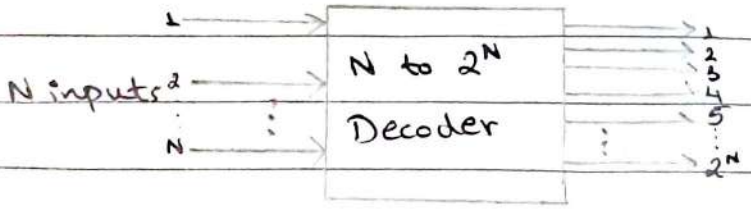

fig.2(1): Diagram of a Decoder.

The 2 to 4 line decoder consists of an array of four AND gates. The 2 binary inputs labelled A and B are decoded into one of the 4 outputs, hence the description of 2 to 4 binary decoder. Each

output represents one of the minterms of the 2 input variables i.e., each output = a minterm.

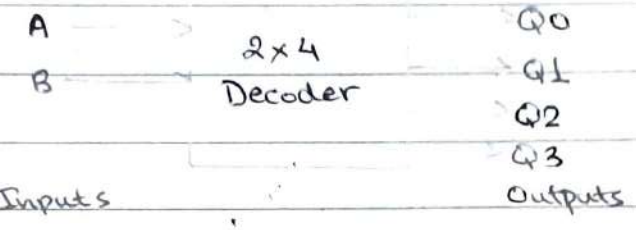

fig 2(ii): A 2×4 binary decoder.

A	B	Q0	Q1	Q2	Q3
0	0	1	0	0	0
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	0	0	1

fig. 2(iii): Truth Table of 2×4 Decoder.

2) 4:2 Encoder:

An encoder is a combinational circuit that performs the reverse operation of Decoder. It has maximum of 2^N input lines and 'N' output lines, hence it encodes the information from 2^N inputs into an n-bit code. It will produce a binary code equivalent to the input, which is active High.

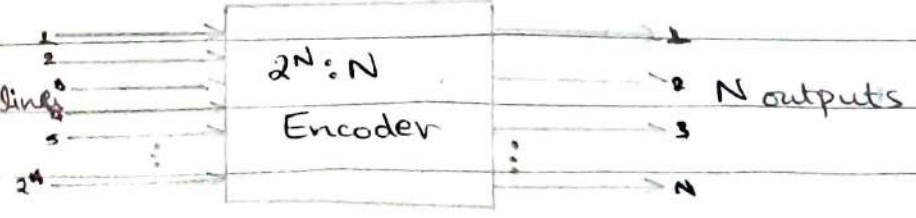

fig. 2(iv): Diagram of an Encoder.

The 4 to 2 Encoder consists of four inputs Y3, Y2, Y1, Y0 and two inputs A1 and A0. At any time, only one of these four inputs can be '1' in order to get the respective binary code at the output.

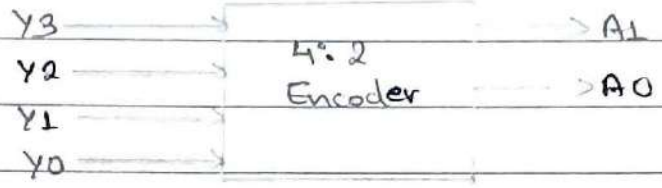

fig. 2(v): A 4:2 binary encoder

Y3	Y2	Y1	Y0	A1	A0
0	0	0	1	0	0
0	0	1	0	0	1
0	1	0	0	1	0
1	0	0	0	1	1

fig. 2(vi): Truth Table of 4:2 Encoder.

Circuit Diagram

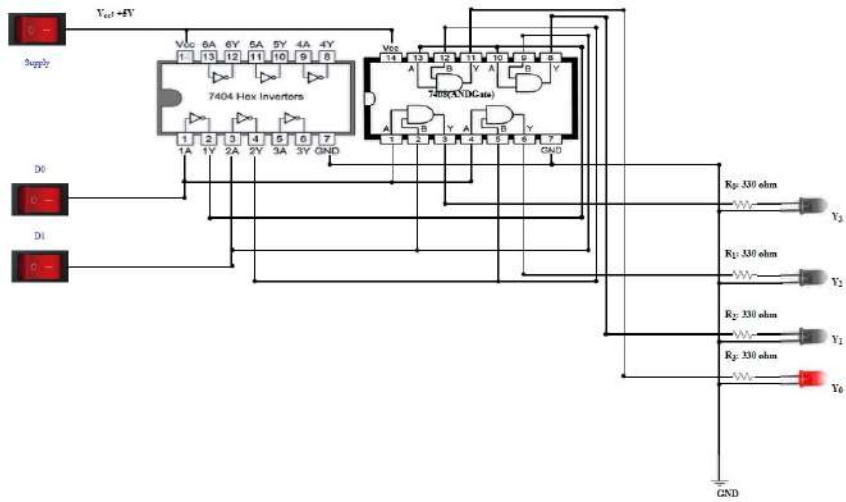

fig. 2 (vii) : Experiment to perform logic of 2x4 Decoder

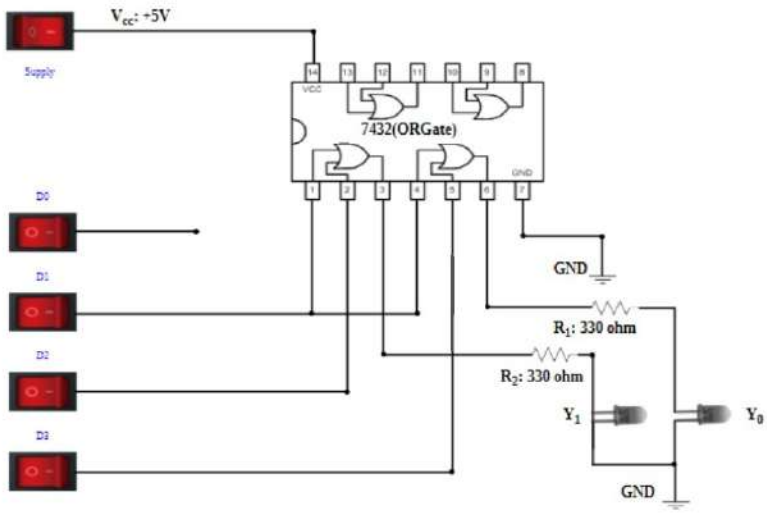

fig. 2 (viii) : Experiment to perform logic of 4x2 Encoder

Observation

TRUTH TABLE Print

S.No.	D_1	D_0	Y_3	Y_2	Y_1	Y_0
1	0	0	1	0	0	0
2	0	1	0	1	0	0
3	1	0	0	0	1	0
4	1	1	0	0	0	1

fig. 2 (ix) : 2x4 Decoder Truth Table

TRUTH TABLE Print

S.No.	D_3	D_2	D_1	D_0	Y_1	Y_0
1	0	0	0	1	0	0
2	0	0	1	0	0	1
3	0	1	0	0	1	0
4	1	0	0	0	1	1

fig. 2 (x) : 4:2 Encoder Truth Table

RESULT:

The truth table for 2x4 Decoder was obtained as shown in fig. 2 (ix)

The truth table for 4:2 Encoder was obtained as shown in the fig. 2(x)

CONCLUSION:

After entering all the values correctly, we got the expected outputs.