

**DEPARTMENT OF MECHANICAL & AEROSPACE ENGINEERING
UNIVERSITY AT BUFFALO
MAE 476/576 Mechatronics
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Mini Assignment 4 – Solution

- 1. Design a Gray Code to BCD converter by the following procedures:**
 - a. Write down the truth table of the converter.**

Binary Coded Decimal (BCD) is a way to store the decimal numbers in binary form. The number representation requires 4 bits to store every decimal digit (from 0 to 9). Since there are 10 different combinations of BCD, we need at least a 4-bit Gray Code to create sufficient number of these combinations.

The truth table is:

Decimal	Gray Code				BCD			
	A	B	C	D	W	X	Y	Z
0	0	0	0	0	0	0	0	0
1	0	0	0	1	0	0	0	1
2	0	0	1	1	0	0	1	0
3	0	0	1	0	0	0	1	1
4	0	1	1	0	0	1	0	0
5	0	1	1	1	0	1	0	1
6	0	1	0	1	0	1	1	0
7	0	1	0	0	0	1	1	1
8	1	1	0	0	1	0	0	0
9	1	1	0	1	1	0	0	1
10	1	1	1	1	D	D	D	D
11	1	1	1	0	D	D	D	D
12	1	0	1	0	D	D	D	D
13	1	0	1	1	D	D	D	D
14	1	0	0	1	D	D	D	D
15	1	0	0	0	D	D	D	D

b. Apply Karnaugh Map to look for the minimized logic expression.

Karnaugh Map for W:

		A				
		00	01	11	10	
C		00	0	0	1	D
		01	0	0	1	D
		11	0	0	D	D
		10	0	0	D	D
		B				D

Minimal Expression for W:

$$W = A$$

Karnaugh Map for X:

		A				
		00	01	11	10	
C		00	0	1	0	D
		01	0	1	0	D
		11	0	1	D	D
		10	0	1	D	D
		B				D

Minimal Expression for X:

$$X = A'B$$

Karnaugh Map for Y:

	A			
	00	01	11	10
00	0	1	0	D
01	0	1	0	D
11	1	0	D	D
10	1	0	D	D

C

$$Y = A'BC' + B'C$$

Karnaugh Map for Z:

	A			
	00	01	11	10
00	0	1	0	D
01	1	0	1	D
11	0	1	D	D
10	1	0	D	D

C

$$Z = A'BC'D' + B'C'D + AD + BCD + B'CD'$$

c. Implement the logic gates by using Circuit Maker.

