ASSIGNMENT No 8

Design and Implement Code Converters Binary to Gray and BCD to Excess 3 code

Objectives:
a] To Understand concept of code converters

Hardware requirements:
Digital trainer kit, IC7404, IC7408, IC7432, Patch cord, +5V Power Supply

Outcomes:
To design combinational circuits using K-map & Boolean algebra.

Theory:
1. Binary to Gray code Converter :-

Gray code system is a binary number system in which every successive pair of number differs in only one bit. Normal Binary may produce an error during transmission from one number to next.
For Example, the States of system may change from 3 (011) to 4 (100) as 011 - 001 - 101 - 100. High chance of wrong state being read.
The Gray code eliminates this problem since only one bit changes its value during any transition between two numbers.

Binary				Gray			
b_3	b_2	b_1	b_0	g_3	g_2	g_1	g_0
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

To find the corresponding digital circuit, we will use the K-map technique.

K-map for g_0

b_3b_2 \ b_1b_0	00	01	11	10
00	0	1	0	1
01	0	1	0	1
11	0	1	0	1
10	0	1	0	1

K-map for g_1

b_3b_2 \ b_1b_0	00	01	11	10
00	0	0	1	1
01	1	1	0	0
11	1	1	0	0
10	0	0	1	1

K-map for g_2

b_3b_2 \ b_1b_0	00	01	11	10
00	0	0	0	0
01	1	1	1	1
11	0	0	0	0
10	1	1	1	1

Kmap for g_3

b_3b_2 \ b_1b_0	00	01	11	10
00	0	0	0	0
01	0	0	0	0
11	1	1	1	1
10	1	1	1	1

Corresponding minimzed boolean expression

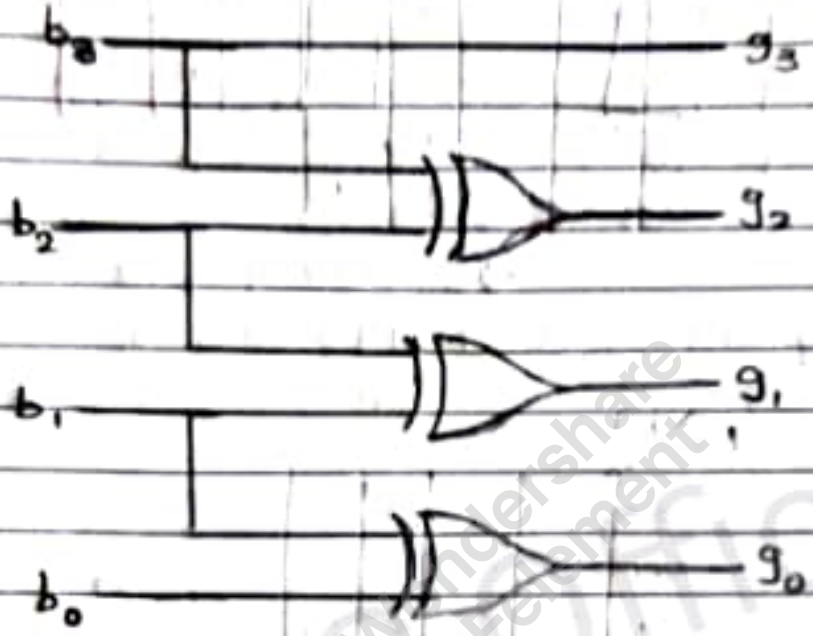
$g_0 = b_0\bar{b}_1 + \bar{b}_1 b_0 = b_0 \oplus b_1$

$g_1 = b_1 \oplus b_2$

$g_2 = b_2 \oplus b_3$

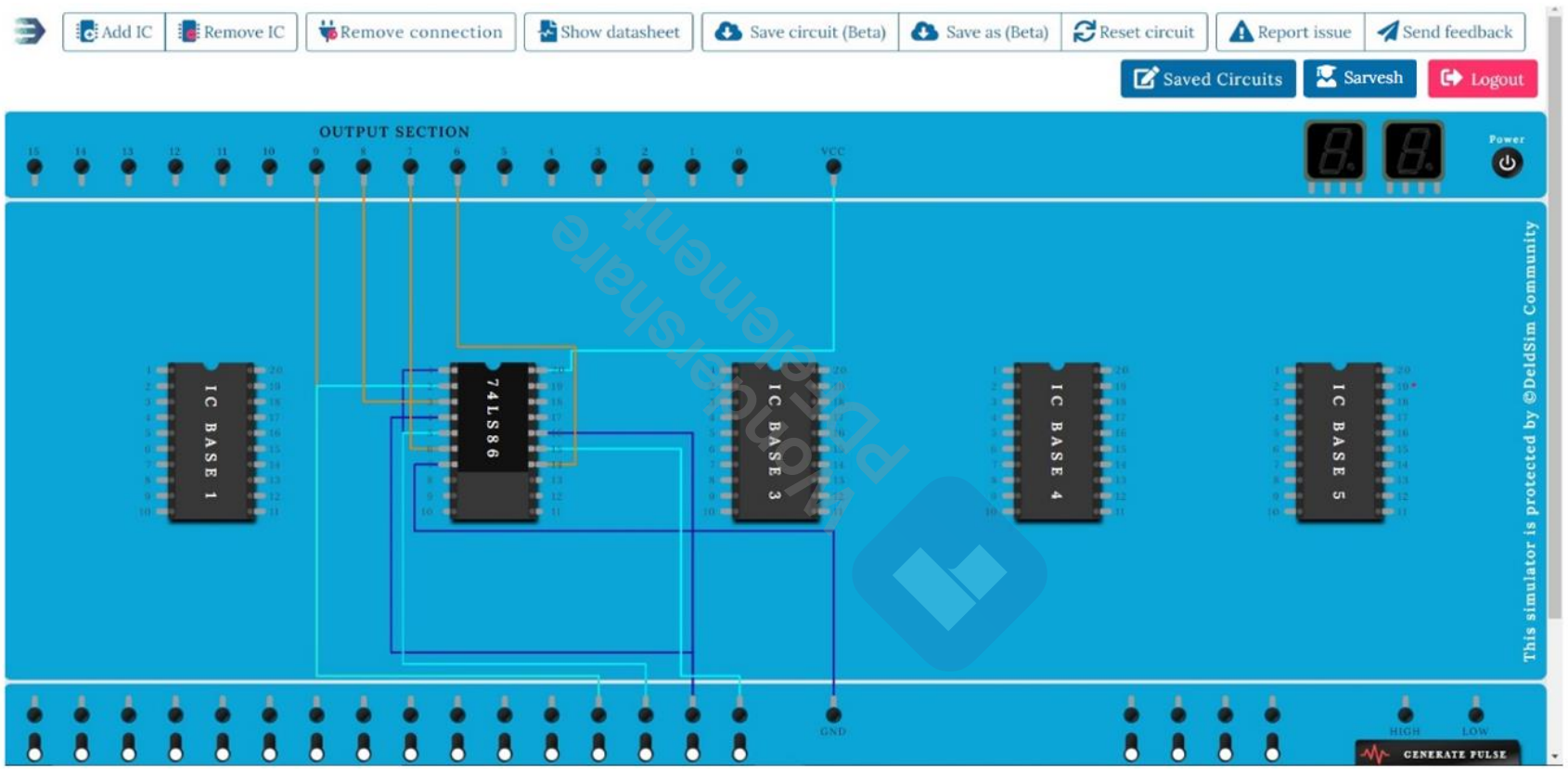
$g_3 = b_3$

Corresponding digital circuit.



2. BCD to Excess-3 code converter

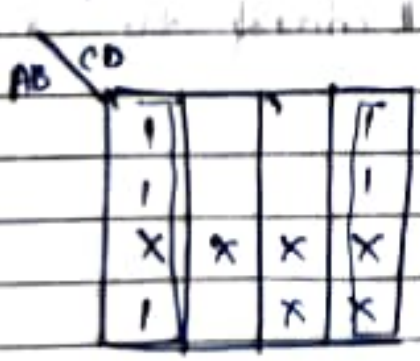
As is clear by the name, a BCD digit can be converted to its corresponding Excess 3 code by simply adding 3 to it.
Let A, B, C and D be the bits representing the binary numbers where D is the LSD and A is the MSB.
Let w, x, y, z be bits representing xs-3 code.



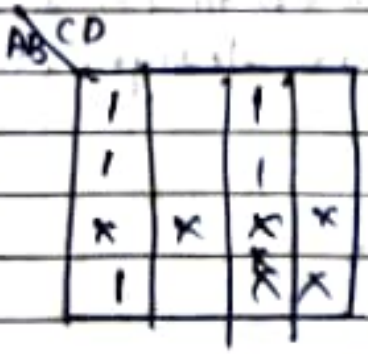
The truth table for the conversion is given below

BCD (8421)				Excess-3			
A	B	C	D	w	x	y	z
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	x	x	x	x
1	0	1	1	x	x	x	x
1	1	0	0	x	x	x	x
1	1	0	1	x	x	x	x
1	1	1	0	x	x	x	x
1	1	1	1	x	x	x	x

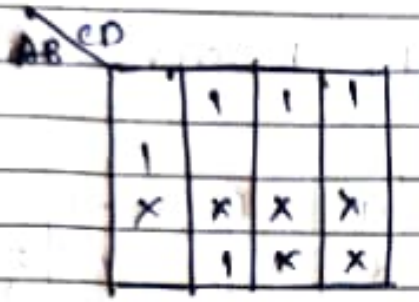
K-map for excess 3 code



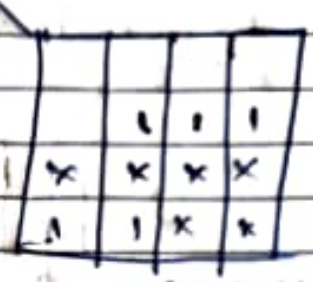
$z = D'$



$y = CD + C'D'$



$x = B'C + B'D + BC'D'$



$w = A + BC + BD$

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

Procedure :-

1. Verify the gates
2. Make the connections as per the circuit dig.
3. Switch on V_{cc} and apply various combinations of input according to the truth table
4. Note down the output regardings. ~~for half/~~

Conclusion :-

Code converter implemented successfully. BCD to Excess 3 & Binary to Gray converter are designed.