Name of Experiment: Design and Implementation of code converter

Aim:

To design and implement 4 bit

(i) BCD to Excess-3 code converter.

(ii) Excess-3 to BCD code converter.

Theory:

Binary coded Decimal (BCD) is used to represent each of decimal digits (0 to 9) with a 4 bit binary code. This code is also known as 8-4-2-1 code as 8421 indicates the binary weights of four bits ($2^3, 2^2, 2^1, 2^0$). It is easy to convert between BCD code numbers and the familiar decimal numbers. It is the main advantage of this code. With four bits, 16 numbers (0000 to 1111) can be represented, but in BCD code only 10 of these are used. The six code combinations (1010 to 1111) are not used and are invalid.

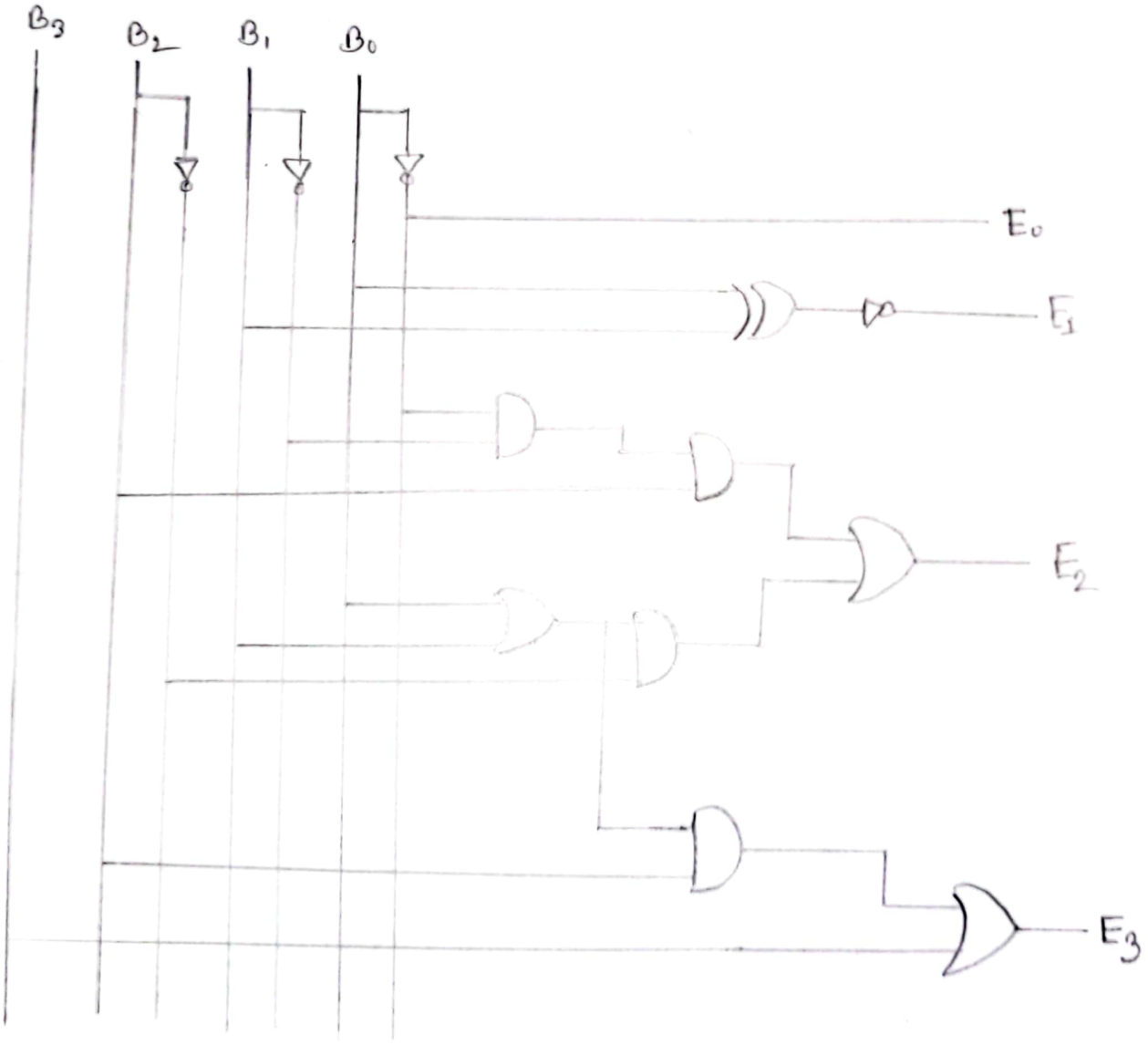
Excess-3, also XS3, is a non weighted code used to express decimal numbers. It can be used for the representation of multi digit decimal numbers as can BCD. The code for each decimal number is obtained by adding decimal 3 and then converting it to a 4 bit binary number.

Apparatus:

1. XOR gate IC-7486
2. AND gate IC-7408
3. OR gate IC-7432
4. NOT gate IC-7404
5. IC Trainer kit
6. Bread Board.
7. Wires.

Logic Diagram:

BCD to Excess-3 converter:



Logic Diagram for BCD to Excess-3 conversion

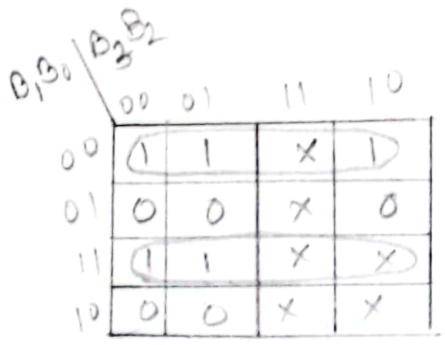
Truth Table:

Input (BCD code)				output (Excess-3 code)			
B_3	B_2	B_1	B_0	E_3	E_2	E_1	E_0
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

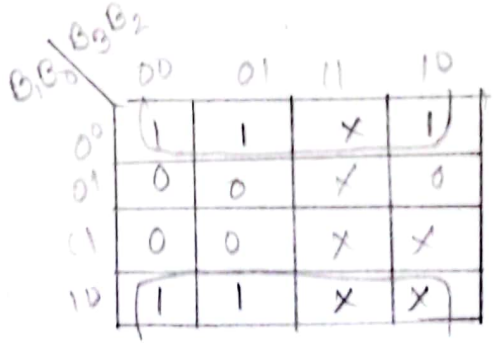
K-map for Reduced Boolean Expressions of each output:

$$F_3 = B_3 + B_2(B_1 + B_0)$$

$$F_2 = \bar{B}_2(B_1 + B_0) + B_2\bar{B}_1\bar{B}_0$$



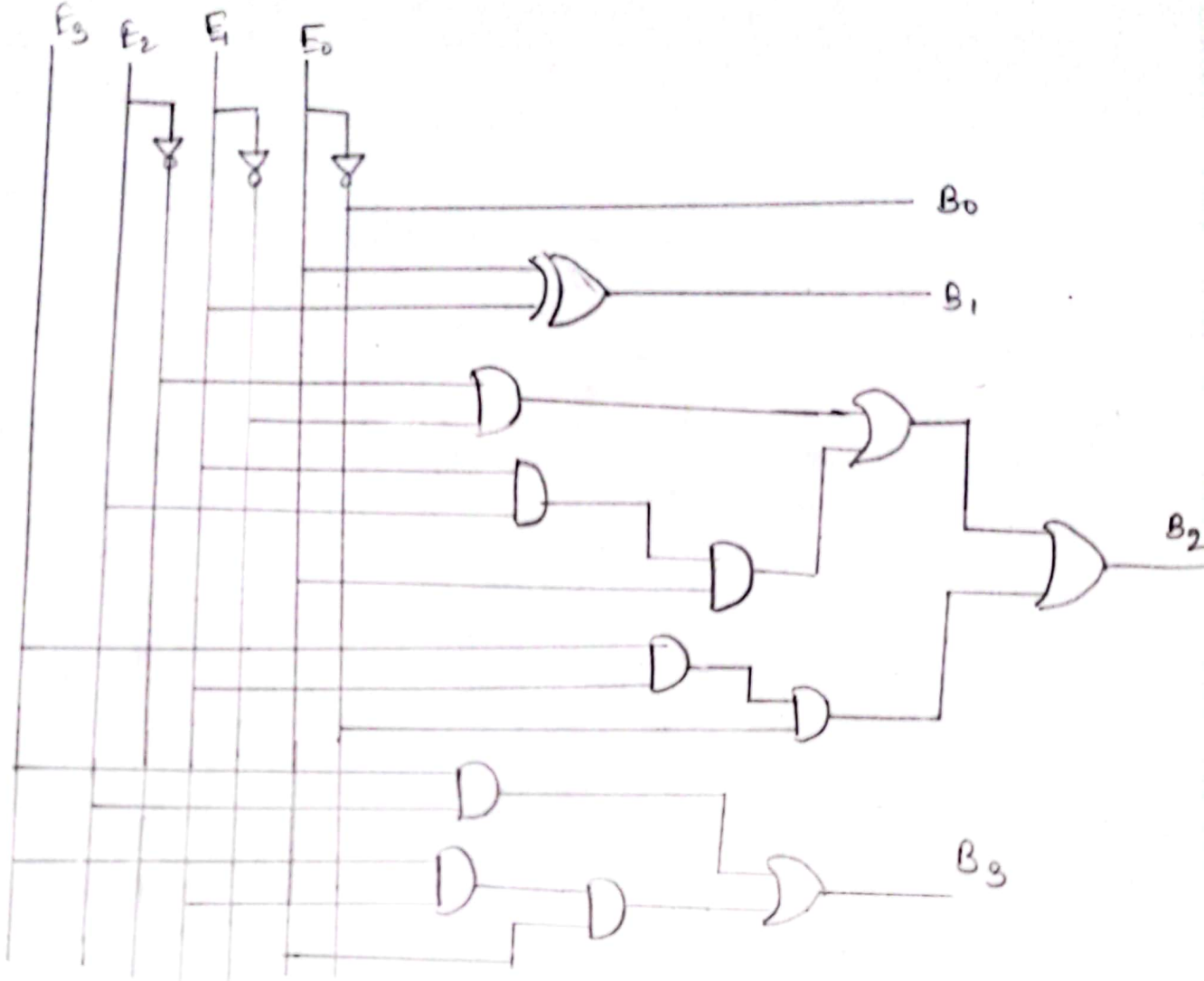
$$F_1 = B_1B_0 + \bar{B}_1\bar{B}_0$$



$$F_0 = \bar{B}_0$$

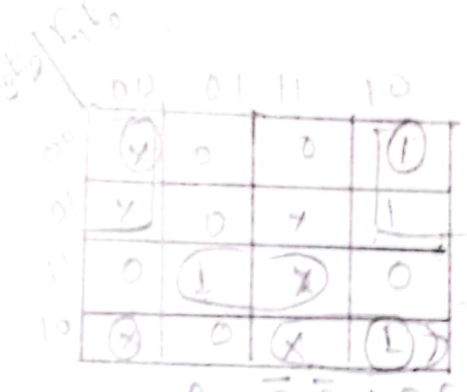
Logic Diagram:

Excess 3 to BCD:



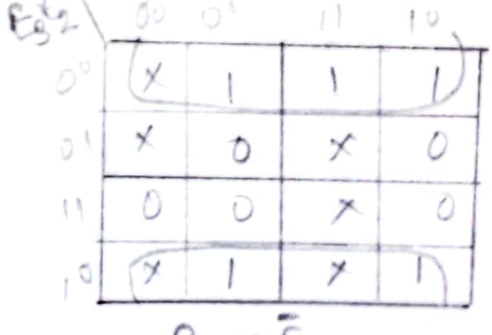
K-map for Each output:

$B_3 = E_3E_2 + E_3E_1E_0$



$B_2 = \bar{E}_2\bar{E}_1 + E_2E_1E_0 + E_3E_1\bar{E}$

$B_1 = \bar{E}_1E_0 + E_1\bar{E}_0$



$B_0 = \bar{E}_0$

Truth Table:

Input (Excess 3)				output (BCD code)			
E_3	E_2	E_1	E_0	B_3	B_2	B_1	B_0
0	0	0	0	x	x	x	x
0	0	0	1	x	x	x	x
0	0	1	0	x	x	x	x
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
1	1	0	1	x	x	x	x
1	1	1	0	x	x	x	x
1	1	1	1	x	x	x	x

Working procedure:

① 4bit BCD to Excess-3 code:

(i) Firstly we checked the components and logic gate for examined the BCD to excess-3 code converter.

(ii) We separated XOR gate (IC 7486), NOT gate (IC 7404) AND gate (IC 7408), OR gate (IC 7432).

(iii) We connected the wires according to the BCD to excess-3 logic circuit.

(iv) finally we checked all inputs according to the truth table of binary BCD to excess-3.

② Excess-3 to BCD code converter:

(i) Firstly we checked the components and logic gate for experiment.

(ii) We separated XOR gate, AND gate, OR gate, NOT gate.

(iii). We connected the wires according to the excess-3 to BCD converter.

(iv) Finally we checked all inputs according to the truth table of excess-3 code converter.

Results:

1. BCD to Excess-3 converter:

We obtained the results using the k-map method—

$$E_0 = \bar{B}_0, \quad E_1 = B_1 B_0 + \bar{B}_1 \bar{B}_0, \quad E_2 = \bar{B}_2 (B_1 + B_0) + B_2 \bar{B}_1 \bar{B}_0$$

$$E_3 = B_3 + B_2 (B_1 + B_0)$$

2. Excess-3 to BCD converter:

We obtained the results using the k-map method—

$$B_0 = \bar{E}_0, \quad B_1 = \bar{E}_1 E_0 + E_1 \bar{E}_0, \quad B_2 = \bar{E}_2 \bar{E}_1 + E_2 E_1 E_0 + E_3 E_1 \bar{E}_0$$

$$B_3 = E_3 E_2 + E_3 E_1 E_0$$

Precaution:

(i). check the connection according to the logic circuit.

(ii) The connection should be properly.

(iii) Check the equipment before starting the experiment.